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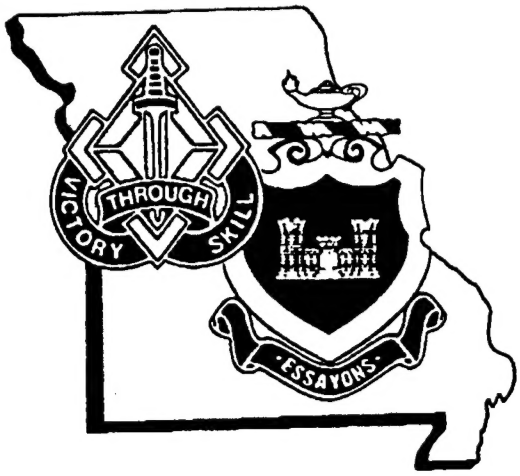
Fauna, Flora, and Sensitive Habitat on Fort Leonard Wood, MO

by Janet E. Sternburg, John Hays, Sharon Sanborn, Loraine McFarland, Hilary Loring, and Bernard Sietman



Land managers of military installations are required to provide a natural environment for military training. At the same time they must meet the Army's commitment to conserving natural resources and threatened and endangered species and the ecosystems upon which they depend. To meet these goals, military land managers must gather information on plants, animals, and natural communities on their installations. This information can help managers make sound management decisions that conserve natural resources while maintaining training schedules.

The present study was conducted on Fort Leonard Wood (FLW), an Army installation of some 63,000 acres located in the upper Ozarks of Missouri. The primary objective of the study was to survey for Federally and state-listed rare and endangered plant and animals and exemplary natural communities. Surveys were conducted for crayfish, freshwater mussels, fish, amphibians, reptiles, birds, plants, and exemplary natural communities between October 1993 and October 1995.

No Federally endangered or threatened species were found on FLW during this survey; however, 24 species of conservation concern were located. Surveys of natural communities indicated that few high quality natural communities remain on this installation. A floristic study of the Falls Hollow sandstone glades on FLW found many weedy, non-native plants interspersed with conservative glade plant species. Management strategies emphasizing landtype associations (i.e., bottomland forests, savanna, upland forests) were developed to enhance natural communities associated with these landtype associations.

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Foreword

This study was conducted for Fort Leonard Wood (FLW) under project MIPR209CER08192 and MIPR303CER013D; work units CU2 and NN3 respectively; titled "Species Surveys for Fort Leonard Wood (Endangered Plant Surveys, Avian Surveys, and Fish and Aquatic Surveys)." The technical monitor was Thomas Glueck, ATZT-DPW-EE.

The work was performed by the Natural History Division of the Missouri Department of Conservation (MDC) under subcontract to The Nature Conservancy. The MDC principal investigator was Janet E. Sternburg, Wildlife Ecologist. Other authors and co-authors included natural history biologists John Hays, Sharon Sanborn, Loraine McFarland, Hilary Loring, and Bernard Sietman, all with the Natural History Division of the MDC. This report is based on a final report published by the MDC and two supporting survey documents:

Sternburg, J.E., J. Hays, S.S. Sanborn, L. McFarland, H. Loring, and B. Sietman, *Threatened and Endangered Faunal and Sensitive Habitat Survey of Fort Leonard Wood Military Reservation, Pulaski County, Missouri*, Final Report of U.S. Department of Defense Contract M67004091-D-0010 (MDC, Jefferson City, MO, 1996).

Hays, John, *A Floristic Survey of Falls Hollow Sandstone Glades, Pulaski County, Missouri* (MDC, Jefferson City, MO, 1996).

Sanborn, Sharon M., and Janet E. Sternburg, *Amphibian and Reptile Survey of Fort Leonard Wood Military Reservation, Pulaski County, Missouri* (MDC, Jefferson City, MO, 1996).

The MDC authors would like to acknowledge the following people from the MDC for providing valued assistance and/or guidance with various aspects of this project: Dennis Figg, Tom Johnson, Tim Smith, Brad Jacobs, Jim D. Wilson, Karen Kramer, Craig Anderson, Mike Leahy, Bill Pflieger, Al Buchanan, Dorothy Butler, Diana Munsterman, Barbara Singleton, Verita Hayden, Mark McGimsey, Andrea Miller, Dave Seibel. Dave Michaelson of the U.S. Fish and Wildlife Service provided technical assistance regarding freshwater mussels. Additional thanks go to the staff

of Fort Leonard Wood in the Directorate of Public Works (DPW), Environment, Energy and Natural Resources Division, Natural Resources Branch: Marv Meyer, Thomas Glueck, Steve Thurman, Joe Proffitt, Richard Edging, Larry Roam, and Curt Rankin, for sharing their knowledge about FLW. And finally, thanks go to the staff of the Directorate of Plans, Training and Mobilization (DPTM), Range Division, Range Control, for their assistance in gaining safe access to weapons ranges and training areas in order to conduct surveys.

The three documents mentioned earlier were consolidated and revised by Rachel A. Shaw, contractor with Colorado State University, under the direction of Dr. Alison Hill, Land Management Laboratory (LL), U.S. Army Construction Engineering Research Laboratories (USACERL). Paul Dubois, formerly of USACERL, initiated and conceptualized the project, while Dr. Hill assumed USACERL responsibility for bringing the project to closure. Dr. John Bandy is acting Operations Chief, CECER-LL. The USACERL technical editor was Linda L. Wheatley, Technical Information Team.

COL James A. Walter is Commander and Dr. Michael J. O'Connor is Director of USACERL.

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1 Introduction

Background

In 1993, the Natural History Division of the Missouri Department of Conservation (MDC) was subcontracted by The Nature Conservancy (TNC) through the Legacy Resource Management Program to gather biological information on Fort Leonard Wood (FLW). The fort is a 62,911-acre military installation in Pulaski County, MO, in the Upper Ozarks Section of the Ozark Natural Division. The primary mission of FLW is to train soldiers for combat. A secondary mission is to provide a natural environment for military training and ensure training activities do not negatively impact rare and endangered species occurring on the installation. To meet both missions, biological data on existing plant communities (condition, quality, age, composition, structure, location) and populations of plant and animal species (condition, location, viability, numbers) must be gathered and evaluated. This information can help FLW's land managers make sound proactive management decisions to conserve existing natural resources, enhance and restore natural community conditions, and reduce negative impacts to the environment due to training activities.

FLW is an active military installation with most of its land devoted to Department of Defense mission training activities. Daily access to many areas on the installation is restricted to ensure personnel safety. To access areas within installation boundaries for purposes of scientific research, surveys, or other official purposes, contact the Directorate of Public Works, Natural Resources Branch, Bldg 2112, 573-596-0871. To access areas within installation boundaries for recreational purposes, contact the Directorate of Community and Family Activities, Outdoor Recreation Center, Bldg 1614, 573-596-4223, for daily access information and safety procedures.

Objectives

The main objective of the study was to provide a comprehensive inventory of state-listed, and certain Federally listed,* species and exemplary natural communities on

* For the purposes of this study, "listed species" are defined as any species Federally listed as Threatened or Endangered or as Candidates for such listing, and species listed in Missouri as Endangered, Rare, Status Undetermined, or Watch List.

FLW. This inventory was compiled by building on existing biological resource information about the managed area, and placing special emphasis on aquatic animals, amphibians, reptiles, birds, plants, and plant communities. Specific objectives of the study include:

Objective 1. Review existing biological resource information of FLW and the surrounding region.

Objective 2. Systematically inventory designated stream reaches on FLW for:
a.freshwater mussels
b. crayfish
c. fish
placing emphasis on locating Federally and state-listed species and their habitats.

Objective 3. Systematically inventory FLW for:
a. amphibians
b. reptiles
placing emphasis on locating Federally and state-listed species and their habitats.

Objective 4. Systematically inventory FLW for birds, including neotropical migrants and resident (breeding) birds, placing emphasis on locating Federally and state-listed species and their habitats.

Objective 5. Conduct a floral inventory of Falls Hollow sandstone glades, an exemplary natural community identified during the Missouri Natural Features Inventory of Pulaski County (Ryan 1992), incorporating one entire growing season.

Objective 6. Evaluate Falls Hollow sandstone glades for possible nomination as a Missouri Natural Area.

Objective 7. Systematically inventory FLW for exemplary remnant natural communities, with emphasis on those that are uncommon, relictual, or harbor rare or endangered plants. Identify locations of Federally and state-listed plant species.

Objective 8. Inventory and characterize the condition of *Juglans cinerea* on FLW.

Objective 9. Identify Federally and state-listed species occurring on FLW but not included in field surveys (e.g., mammals, eagles).

Objective 10. Develop management recommendations that protect and enhance sensitive species and their habitats. Include management of forest interior birds, aquatic ecosystems, and other areas of interest (e.g., glades, bottomland forests).

Approach

Six field biologists made a total of 348 visits to FLW over the 2 years between 26 October 1993 and 15 October 1995. Surveys were conducted for crayfish, freshwater mussels, fish, amphibians, reptiles, birds, plants, and exemplary natural communities.

Standard inventory procedures used by most natural heritage programs were used to identify potential occurrences of Federally and state-listed species and exemplary natural communities for this report. These procedures include: (1) compilation of existing information, (2) examination of topographic maps and aerial photographs, (3) initial ground survey, and (4) final field survey. Methodology specific to each project objective is described in detail in Chapter 3.

Because common names are more frequently in existence and somewhat more standardized for animals than is the case for plants, references to plant and animal species in the text have been handled differently. Throughout the text, animals are referred to by common name, while plants are referred to by scientific name. The appendix contains a master list of all species mentioned in this report. The list is alphabetized by scientific name for plants and by common name for animals. Corresponding scientific names are provided for all animals and for plants where available.

Mode of Technology Transfer

Findings of Federally and state-listed species are provided for use by FLW land managers. Certain information omitted here, such as locations of areas sampled and Element Occurrence Records from the Missouri Natural Heritage Program, is available in the appendices of a previous report (Sternburg et al. 1996). This report is also available on the USACERL web page at http://www.cecer.army.mil.

2 Study Site

Fort Leonard Wood Today

FLW comprises 62,911 acres in south central Missouri, primarily in the southern portion of Pulaski County (Figure 1). Small land parcels are located in southeast Laclede County (1,020 acres) and northwest Texas County (20 acres). FLW is bounded on the east by Big Piney River, on the west by Roubidoux Creek, and on the north by the towns of St. Roberts and Waynesville. Except for its northern boundary, FLW is surrounded by Mark Twain National Forest. The fort is approximately 30 miles west of Rolla, and 68 miles south of Jefferson City.

FLW is an active military installation with most of its lands devoted to training purposes. Approximately 56,900 undeveloped and unimproved acres are used for training activities. Training ranges are located primarily in the southern two-thirds of the installation. Access to many training ranges or areas is restricted to ensure personnel safety. Anyone desiring access to areas within the installation boundary for purposes of scientific research, surveys, or other official purposes are required to contact the Directorate of Public Works (see **Background**, p 9).

FLW is in the Upper Ozark Section of the Ozark Natural Division (Thom and Wilson 1980; Figure 1). The great age and physiographic diversity of the Ozarks make it the region of greatest species diversity in Missouri with a distinct biota that includes many endemics. The Upper Ozark Section is part of the Salem Plateau, an ancient, uplifted plain long exposed to the dissective action of many rivers and streams. Stony and gravelly soils cover most of the gently rolling upland portions of the Ozark region. Rivers and stream-cut ravines and hollows lead into deep, steep-sided valleys.

While the smaller stream courses in the region tend to be gravelly or stony, the larger river valleys may contain fine-grained alluvial deposits (Sauer 1920). Dolomite and sandstone glades and bluffs, springs, fens, caves, sinkholes, losing streams, and streams with entrenched meanders are common in this area.

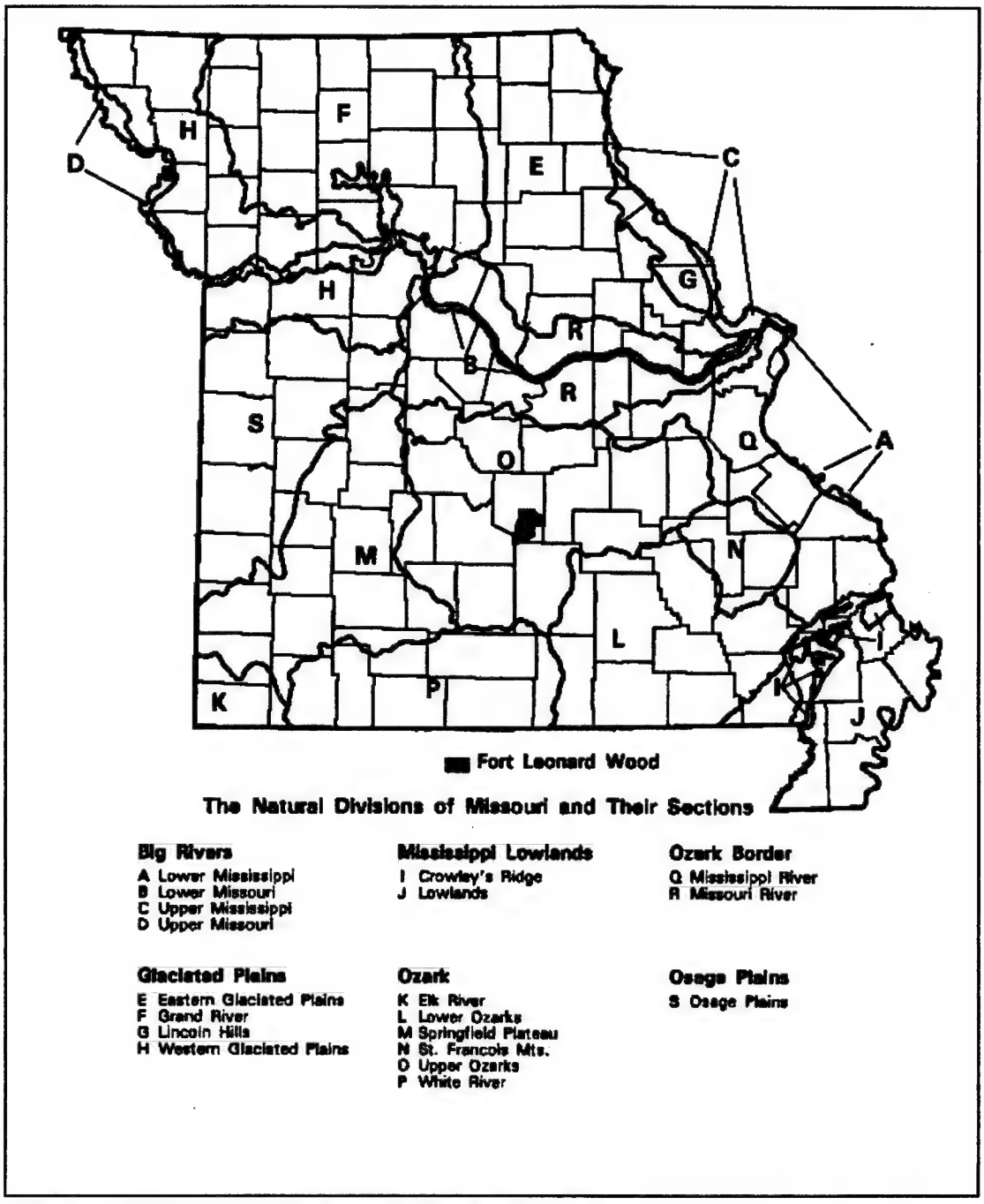


Figure 1. Location of Fort Leonard Wood, Pulaski Co., MO.

Land Use

Pre-European Settlement Vegetation

The pre-European settlement vegetation of this region can be surmised from the accounts of early travelers and from the survey notes of the U.S. General Land Office Survey of Missouri (1815-1850s). The area now occupied by FLW was

surveyed between the 1820s and the 1850s. The surveyors' field notes describe an area of uplands covered in forest and savanna sloping down to bottomland deciduous forests along the numerous streams. They also noted occasional areas of prairie, especially in the upland areas of FLW. Most of the area now occupied by FLW was described as broken, stony, poor soil, and unfit for cultivation.

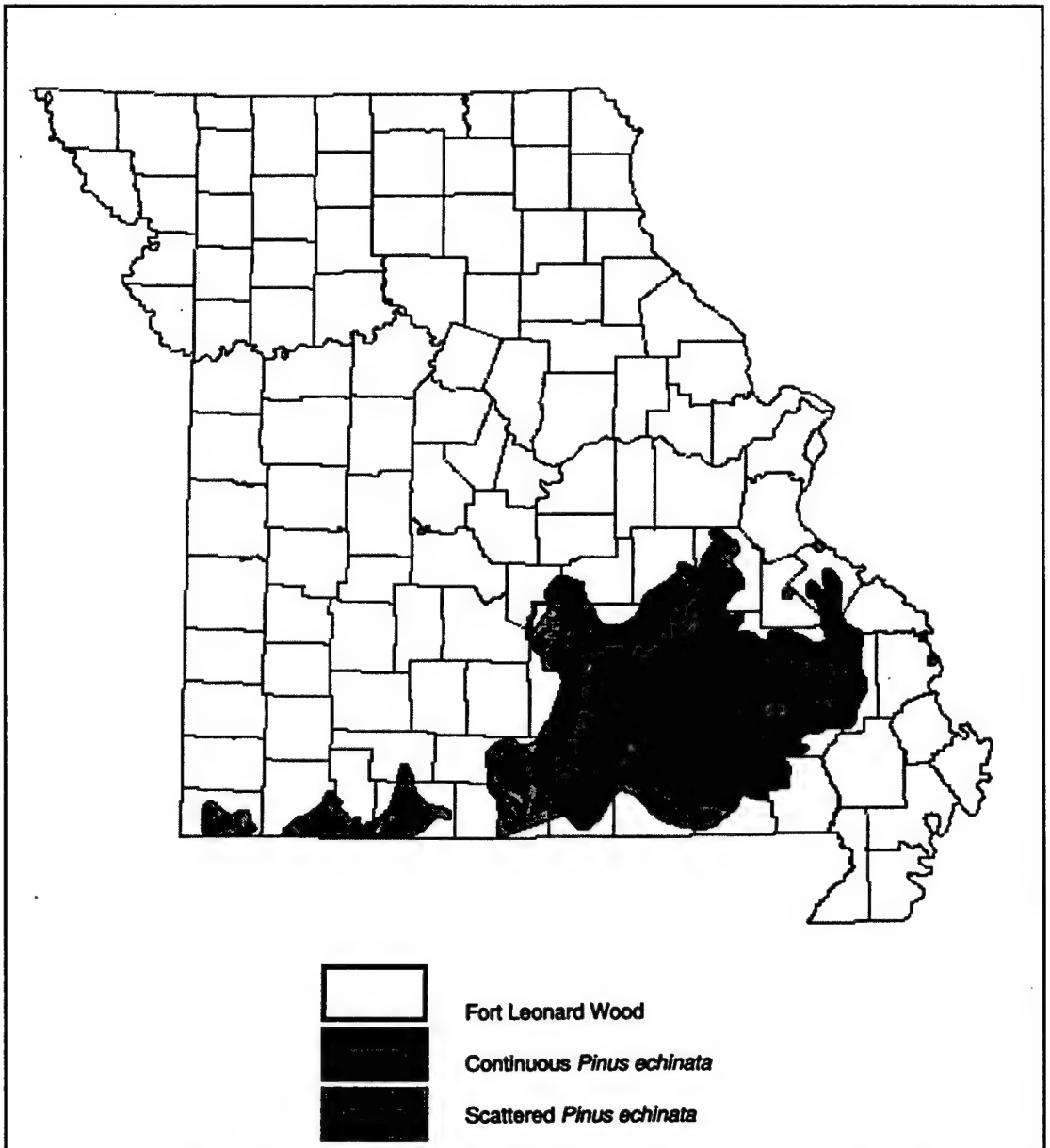
The upland tracts, as described in the surveyor's notes, contained *Quercus alba, Q. stellata, Q. rubra, Q. velutina, Q. marilandica, Carya tomentosa, and C. texana.* Commonly recorded understory species included *Quercus* spp., *Carya* spp., *Corylus americana, Morus* spp., *Aesculus glabra, Sassafras albidum, Rhus* spp., *Vitis* spp., and undetermined vines.

Besides *Quercus* spp. and *Carya* spp., trees recorded in the valleys included *Juglans nigra, Fraxinus* spp., *Ulmus* spp., *Acer* spp., *Platanus occidentalis, Betula nigra, Morus* spp., *Acer negundo,* and *Celtis occidentalis. Asimina triloba* and *Lindera benzoin,* as well as immature individuals of the previously mentioned large tree species, were often cited as understory vegetation (U.S. General Land Office Survey 1815-1850s).

In the early 19th century, forests of *Pinus echinata* could be found throughout the Lower Ozarks and in scattered tracts in the Upper Ozarks (Kucera 1961; Figure 2). Kucera (1961) noted that *P. echinata* occurred in the southeast portion of Pulaski County. However, large stands of *Pinus* probably did not exist on FLW. Most forests of *P. echinata* in the Ozarks were cleared by late-19th century logging.

Henry R. Schoolcraft kept an extensive journal as he traveled through the Ozarks in 1818-1819. As quoted in Park (1955), Schoolcraft described the upland regions as:

> ...a high-land prairie with little timber, or underbrush, and covered with grass...a tract of high-land generally level, and with very little wood or shrubbery. It is a level woodless barren covered with wild grass, and resembling the natural meadows or prairies of the western country in appearance, but lacks their fertility, their wood, and their remarkable equality of surface. ... Now and then an oak stood in our path; sometimes a cluster of bushes crowned the summit of a sloping hill...



(Source: Modified from *The Grasses of Missouri* by Clair L. Kucera, by permission of the University of Missouri Press. Copyright (c) 1961 by the Curators of the University of Missouri.)

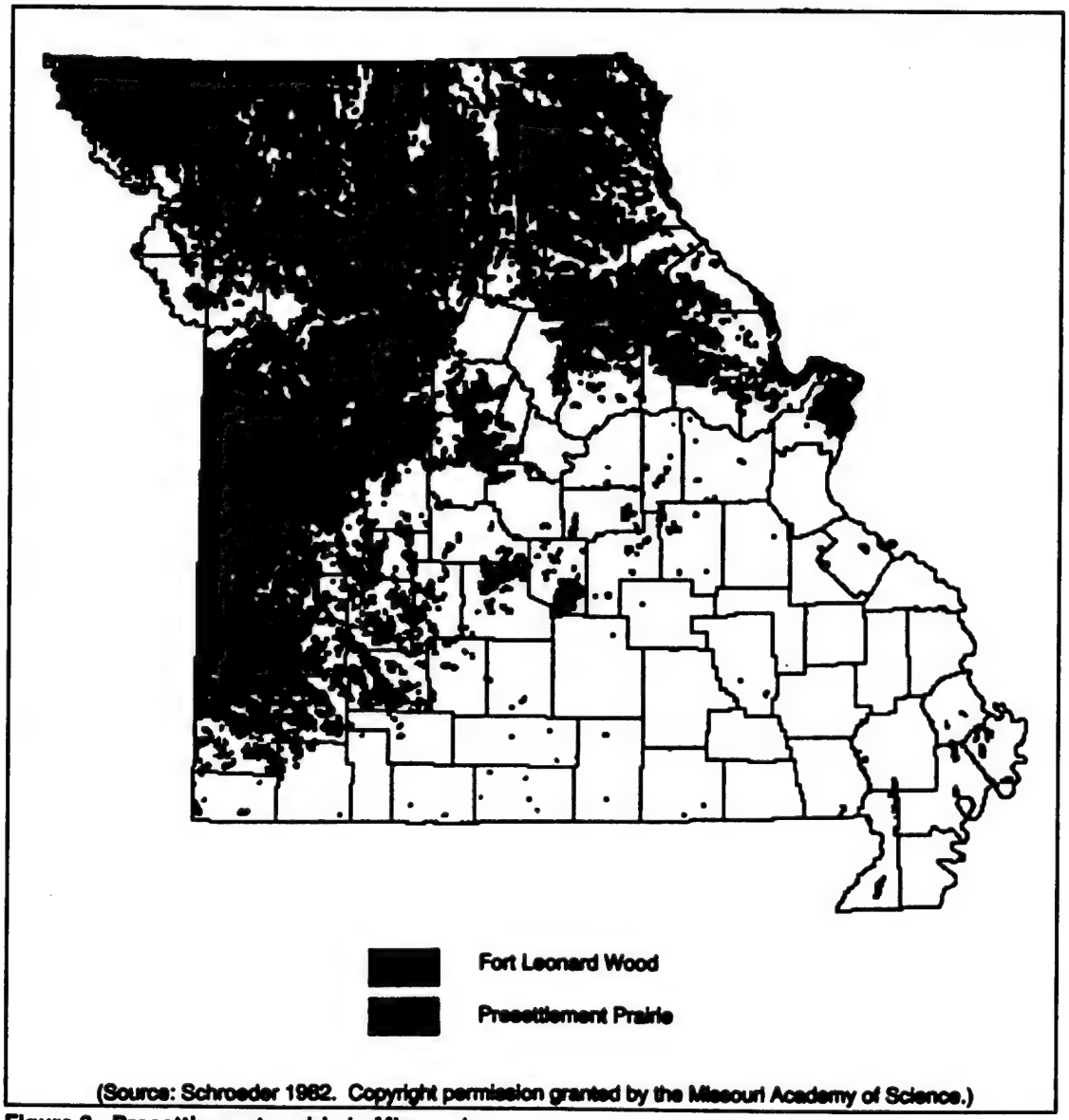
Figure 2. Historic range of *Pinus echinata* in Missouri.

Marbut (1911) had this to say about the region:

> The greater part of the Ozark dome...was up to the middle of the nineteenth century a region of open woods, large areas being almost treeless. Except on the roughest land...the timber growth was not dense enough to hinder in any way the growth of grass. The whole region in its vegetation was more closely allied to the western prairies than to the timber-covered Appalachians...Along all the permanent streams, occupying usually the whole of the alluvial belts, there was commonly a heavy growth of timber.

The vegetation of FLW probably consisted mainly of oak-hickory forests or savannas, prairies, and a few glades on exposed, south-facing slopes with shallow soils. A mid-19th century geologic map of Pulaski County described the vegetation of the uplands between the Big Piney River and Roubidoux Creek as consisting largely of "post oak flats" (American Resources Group, Ltd. 1989).

Schroeder (1982) described the presettlement prairie in the Ozarks as "discrete landscape units on a rolling-to-level upland, bounded by wide belts of timbered hill country along the stream valleys entrenched in the Ozark limestones." Small, isolated patches of presettlement prairie occurred within the boundaries of FLW (Schroeder 1982; Figure 3).



(Source: Schroeder 1982. Copyright permission granted by the Missouri Academy of Science.)

Figure 3. Presettlement prairie in Missouri.

Today, the savannas have largely been replaced by forests. Many people believe that fire was a major influence on the presettlement landscape. In addition to wild fires, Goodspeed Publishing Co. (1889) mentions that Native Americans often used fire to improve hunting conditions.

The lifestyle of the European settlers changed the fire regime that was partly responsible for the presettlement landscape. The frequency of fires in a nearby area was shown to have dropped dramatically after settlement despite a decrease in rainfall (Guyette and McGinnes 1982). Once the burnings ceased, young trees were able to survive, and today, forests exist where timber was once sparse (Goodspeed Publishing Co. 1889). However, fire is not the only factor that could have contributed to the maintenance of widespread savannas. Forest development in level upland areas can be inhibited by the presence of an impermeable fragipan layer in the subsoil. Other factors possibly responsible for the formation of barrens are climate, edaphic conditions, herbivory, insects, disease, and windstorms.

Arrival of European Settlers

Large-scale use and manipulation of the natural resources in the region did not begin until the arrival of Europeans. The earliest recorded non-native people to visit this area were the French traders and trappers who traveled up the rivers seeking furs. Lead miners also traveled through the region as early as 1719. They found a countryside teeming with game such as deer, wild turkey, and fur-bearing animals. Edible berries in this area included wild cherries, strawberries, service berries, wild grapes, may apples, persimmons, and paw paw (Pulaski County Historical Society 1982).

About the time that Missouri became a state (1821), settlers began trickling in from the South. They lived by hunting, fishing, and subsistence farming (corn and hogs). Farms were established in the river valleys and larger hollows and, somewhat later, in the less rugged upland areas. Areas that were not suited to cultivation were commonly logged or cleared for pasture.

Most of the timberland was cut over as the early settlers cleared the land to build their homes and to produce crops. As early as 1816, saw mills were established along the Big Piney River in Texas County to harvest *Pinus echinata*. From 1830 to 1860 the counties of this area were organized and the villages and hamlets began to grow. Logging increasingly became one of the dominant industries of the region. With the coming of the railroad, the making and shipment of railroad ties became an important industry. Small, portable saw mills moved across the county exhausting most of the timber suitable for ties, rough lumber, and stave bolts. The

Ozark lumber industry boomed from 1880 to 1920, and millions of board feet of lumber were harvested.

Land-clearing activities were not limited to lumbermen. Settlers also cut timber for firewood and building materials, and to clear land for crops or livestock. Some settlers also burned portions of their lands to improve growth of annual grasses for grazing. In many areas of the Ozarks, these land-use practices, among others, resulted in severe and rapid erosion of the shallow Ozark soils and soil depletion, which had severe adverse economic effects. In the 1930s, the U.S. Forest Service began buying the most severely eroded and deforested lands to restore and conserve the resource base. This practice resulted in the establishment of Mark Twain National Forest.

History of Fort Leonard Wood

Information on the history of FLW was taken from several documents (Ecological Services Center n.d.; Harland Bartholomew and Associates, Inc. 1991, 1995a; Proffitt 1994). The U.S. Forest Service (USFS) and FLW staffs also provided information.

During the 1930s, after the purchase or condemnation of many acres of land by the U.S. Forest Service, the Works Progress Administration, as part of the unemployment relief program, established a Civilian Conservation Corps (CCC) Camp near St. Roberts. It was upon the site of an abandoned CCC Camp that the Seventh Corps Training Center was established in 1940. The name was later changed to honor Major General Leonard Wood, and again changed in 1941 to indicate that the installation was an Engineer Replacement Training Center. Deactivated after WWII, Camp Leonard Wood was maintained by a small work force between 1946 - 1950. Limited training by Army and National Guard units continued during the summer months. In 1950, shortly after the outbreak of fighting in Korea, the Camp was reactivated. In 1956, the installation was renamed the U.S. Army Training Center, Engineer. The installation was later designated as a permanent post and became known as Fort Leonard Wood.

Land acquisition for FLW began with permission from the U.S. Department of Agriculture to use National Forest lands within the military reservation boundaries. The remaining lands within FLW boundaries were then acquired from private landowners, bringing the total acreage to almost 71,000 acres. Several land exchanges, affecting 16,000 acres, were made with USFS to consolidate USFS lands in the northwest (approximately 9,700 acres) and the northeast (approximately 6,300 acres) portions of the installation. As a result of a General Services Administration

land utilization survey, the boundary in the northeastern portion of FLW was redrawn to exclude the USFS property as well as several other small USFS parcels scattered at the periphery of the installation (FLW-DPW Natural Resources file information). This action brought FLW to its current size of 62,911 acres, including the 9,672 acres of USFS land. The Army is authorized to use the USFS land for certain military training activities under a Memorandum of Agreement.

3 Methods

Objective 1 — Biological Literature Review

Existing information on the study area's natural communities, geology, soils, flora, fauna, and other special features was collected from many sources, including published and unpublished scientific reports, the Missouri Natural Heritage Database (NHD), agency files, the Pulaski County soil survey (Wolf 1989), geologic maps, FLW and MDC resource managers and biologists, and knowledgeable university staff. Guides to the flora and fauna of Missouri were consulted to determine species potentially occurring on FLW. These species include: freshwater mussels (Oesch 1984), fish (Pflieger 1975), crayfish (Pflieger 1987), birds (Robbins and Easterla 1992), mammals (Schwartz and Schwartz 1981), amphibians and reptiles (Johnson 1992), and plants (Steyermark 1963). Environmental Impact Statements and Ecological Assessments (Harland Bartholomew and Associates, Inc. 1991, 1995a, 1995b) and a Biological Assessment (3/D Environmental 1996) were also reviewed.

Objective 2a — Freshwater Mussel Surveys of Designated Stream Reaches

Streams were accessed either by canoe or on foot. The initial approach to viewing the substrate and locating freshwater mussels was by wading and using viewing boxes (clear plexiglass boxes). Later snorkeling and SCUBA* gear were used. Sampling sites were located by noting areas that had a prevalence of dead shells, shallow riffle areas, or shallow areas near the stream bank. If no mussels were found after one man-hour, the researchers moved to the next site. All live mussels encountered were identified, counted, and returned to the substrate. Dead specimens were identified, but not counted. Specimens that could not be readily identified were placed in a 70 percent ethanol solution for later identification. Time spent searching, substrate description, and location were recorded for each site. All occurrences of listed mussels were noted and added to the Missouri NHD. Vouchers were deposited in the mollusk collection at Ohio State University, Columbus. Surveys were conducted between October 1993 and October 1995.

* Self-Contained Underwater Breathing Apparatus.

Objective 2b — Crayfish Surveys of Designated Stream Reaches

Streams were accessed either by canoe or on foot. Crayfish were identified during fish and freshwater mussel surveys. Crayfish observed or captured during these surveys were identified and noted. Surveys were conducted between October 1993 and October 1995.

Objective 2c — Fish Surveys of Designated Stream Reaches

Streams were accessed either by canoe or on foot. A drag seine (1/4-in. mesh, 8 ft deep by 15 ft long) and a kick seine (1/16-in. mesh, 4 ft deep by 6 ft long) were used to sample fish. Sites were selected to represent existing aquatic habitats. Targeted listed species were surveyed by concentrating on all habitat suitable for that species. Sites were seined until it appeared no new species were captured (i.e., approx. 30 to 40 minutes of seining per site). Fish were identified, counted, and returned to the stream. Specimens that could not be readily identified were placed in a 10 percent formalin solution for later identification. Additionally, because of the high level of mortality associated with seine surveys in the hot summer months, all dead individuals were collected for later identification. Location, and general substrate and bank descriptions were noted for each site. All occurrences of listed fish were noted and added to the Missouri NHD. Voucher specimens were deposited in the Ichthyology Collection at Southern Illinois University, Carbondale. Surveys were conducted between April 1994 and October 1995.

Objectives 3a-b — Amphibian and Reptile Surveys

Several census methods were used to conduct a comprehensive survey of the amphibians and reptiles of FLW. Additionally, all incidental observations were recorded. Surveys were conducted between 28 March and 15 October 1995. With the exception of captures representing new county records, all amphibians and reptiles captured during the survey were identified and released. All occurrences of listed amphibians and reptiles were noted and added to the Missouri NHD. Voucher specimens will be deposited at the Natural History Museum at the University of Kansas, Lawrence. Methods used include:

- *Special habitat search* — Listed species were surveyed by targeting and searching suitable habitats. Leaf litter was searched, and rocks and logs were turned over.

- *Funnel traps* — Four unbaited funnel traps were placed along natural drift fencing (downed trees, large rocks) on 20 Land Condition Trend Analysis (LCTA) wildlife plots. Plots were chosen to represent available habitat. Traps that failed to capture amphibians or reptiles by the third visit were relocated within the plot. Traps were checked every 3 to 4 days and at least 15 times during the trapping season.

- *Terrestrial time search* — Each LCTA wildlife plot used for funnel trapping was also searched for two man-hours, by turning rocks and logs, and raking up leaf litter.

- *Aquatic funnel traps* — Ten baited traps were placed at two locations on or near Big Piney River and one location on Roubidoux Creek. Traps were checked twice a day for 2 days. Traps that had not caught turtles by the third visit were pulled or relocated.

- *Aquatic time search* — One man-hour spent seining and dipnetting on several aquatic communities located throughout the installation.

- *Frog and toad breeding call survey* — Ten sites were surveyed in 1994 and 1995. Surveys began 1 hour after sunset, and frogs and toads were identified by song and counted for 10 minutes at each site. This survey was run at least three times each year.

- *Road cruises* — Certain roads were driven at slow speeds between 8 p.m. and 6 a.m. All amphibians and reptiles observed on the road were collected, identified, and released.

Objective 4 — Resident and Migratory Bird Surveys

Field surveys concentrated on areas with habitat suitable for targeted species. Instead of using a standardized point-count method, surveys were conducted by walking parallel lines through the area being surveyed, and recording all birds seen and heard. Taped calls were played to elicit a response from Cooper's hawks and Sharp-shinned hawks. Roubidoux Creek and Big Piney River were traveled by canoe to inventory riparian birds. Morning bird surveys began 1/2 hour before sunrise and ended at midday. Evening bird surveys began 1 hour before sunset and ended approximately at dark. Species identification, evidence of reproduction, and location were noted for every listed species observed. All occurrences of listed birds

were noted and added to the Missouri NHD. Surveys were conducted between 18 May and 30 September 1994 and 18 April and 20 September 1995.

Objective 5 — Floral Inventory of Falls Hollow Sandstone Glades

During the Missouri Natural Features Inventory of Pulaski County, a small glade complex on Roubidoux sandstone was identified at the top of Falls Hollow, adjacent to Range 22 on FLW (Ryan 1992). A floristic inventory of Falls Hollow sandstone glades was conducted to develop a comprehensive plant list of the area. All plants encountered on the sandstone glades were identified. Species that were difficult to identify were sent to the Missouri Botanical Garden, St. Louis, for identification. Species new to Pulaski County were collected and a voucher specimen sent to the Missouri Botanical Garden. The glades were visited approximately every 10 days during the growing season between 1 April and 23 October 1994.

Objective 6 — Falls Hollow Sandstone Glade Natural Area Evaluation

Falls Hollow sandstone glade was evaluated for Natural Area status in 1995 by Karen Kramer, Natural Areas Biologist (MDC). The area was visited and compared to a sandstone glade on Roubidoux Formation located on Mark Twain National Forest. The conditions of both areas were evaluated for the presence of exotic plants, weedy plant invasion, existence of a protective buffer, conservative plants, listed species, and overall natural community quality. The best representative of a natural community with the greatest potential for preservation is selected to be included in Missouri's Natural Areas System.

Objective 7 — Federally and State-Listed Plant and Exemplary Natural Community Surveys

Listed plants and exemplary natural communities were surveyed as part of the floristic inventory of Falls Hollow sandstone glades. Listed species potentially occurring on FLW were searched for during their respective flowering periods. All occurrences of listed plants were noted and added to the Missouri NHD. Voucher specimens were deposited at the Missouri Botanical Garden. This survey was conducted between 1 April and 23 October 1994.

Objective 8 — *Juglans cinerea* Survey

Juglans cinerea on FLW were surveyed to report on their location and current condition. Nineteen drainages and ravines were chosen for examination. *J. cinerea* populations were known to exist in some of these areas. Other sites were selected to provide a variety of underlying bedrock, geographic location, aspect, and elevation. All *J. cinerea* noted within the designated drainages were examined and assessed for health, as evidenced by canopy dieback, cankers, adventitious shoots, stained bark, or the presence of hyphal pegs. Diameter at breast height (DBH) and location were recorded for each tree, and fruiting trees were noted. This survey was conducted between 30 January and 2 April 1995.

Objective 9 — Federally Endangered Species and Other Listed Species Not Included in Field Surveys

This project was not designed to address the Federally listed species known to occur on FLW, specifically, gray bat, Indiana bat, and bald eagle. This work was contracted to 3/D Environmental of Cincinnati, OH, as part of a Biological Assessment to determine the impact of current training practices on these species (3/D Environmental 1996). Their project included extensive mist netting to determine bat movement throughout the installation. However, this report would be incomplete without mentioning the occurrence of gray bats, Indiana bats, and bald eagles on FLW.

One invertebrate species, the American burying beetle is not known to occur on FLW and was not included in this study. However, as this species is listed as Endangered both federally and by Missouri, occurrence of this species on FLW will be discussed based on recent studies in nearby states.

Existing records of other listed species, specifically, mammals and invertebrates, were gathered and are noted in this report.

Objective 10 — Biological Diversity and Ecosystem Management Recommendations

Management recommendations were developed based upon information gathered during this and previous biological surveys of FLW. Known biological resources occurring on the installation were evaluated, and a determination was made as to

whether current management techniques adequately addressed the biodiversity of the area.

4 Results and Discussion

Findings for each of the objectives are discussed in the following sections. Tables can be found at the end of the chapter.

Objective 1 — Biological Literature Review

The initial literature review produced a list of Federally and state-listed species of plants and animals that might occur on FLW. The purpose of this list was to guide species investigations to be made during the course of field work (i.e., searches were not limited to the species identified on the preliminary list). Those species for which surveys were conducted are noted in Table 1.

Studies Directed at FLW

Few biological studies were conducted on FLW until recently. Within the last 10 to 15 years, several studies focusing on the biological resources of FLW were completed to help land managers make informed decisions concerning usage of natural resources. Brief summaries of these projects are presented.

Cave Resources of Fort Leonard Wood: An Inventory and Evaluation (Oesch and Oesch 1986). A comprehensive inventory and evaluation of the cave resources of 45 caves. Survey was conducted in 1985-1986.

Floral Inventory of Fort Leonard Wood, Missouri (Johnson et al. 1990). A comprehensive plant inventory completed between April and October 1989.

Rare and Endangered Plant Survey of Fort Leonard Wood Military Reservation (Skinner 1991). A systematic search for Federally and state-listed plants. Survey was conducted between May and December 1991.

Revised Rare and Endangered Plant Survey of Fort Leonard Wood Military Reservation (Skinner 1993). This revision of Skinner's 1991 report excludes Section B: Corrections to the Floral Inventory (of FLW).

Wetlands Inventory for Fort Leonard Wood, Missouri (Harland Bartholomew and Associates, Inc. 1995b). A survey to locate and characterize the wetlands occurring on FLW, determine jurisdictional wetlands regulated under provisions of Section 404 of the Clean Water Act and identify possible management strategies to protect/enhance existing wetlands. Field work was conducted between August 1993 and September 1994.

Biological Assessment of the Master Plan and Ongoing Mission (3D/Environmental 1996). Studies were conducted to assess effects of military training on Indiana bats, gray bats, and bald eagles on FLW. Field work was conducted in 1994-1995 and entailed mist-netting, radiotelemetry, and visual observations.

Prehistoric Mussel Fauna studies (Warren 1993, 1995a, 1995b). Reports characterize the prehistoric freshwater mussel fauna of Big Piney River and Roubidoux Creek based on freshwater mussel shells found in caves on FLW during archeological studies.

Two ongoing biological monitoring programs on FLW gather data that are useful when conducting surveys for listed species. These programs are:

- LCTA — An ongoing program initiated in 1989 on FLW as part of the ITAM (Integrated Training Area Management) program. Land, vegetation, and wildlife resources are evaluated using baseline information gathered from permanent plots located throughout FLW (Proffitt 1994).

- Monitoring Avian Productivity and Survivorship Program (MAPS) — An ongoing project initiated in 1993 on FLW. A cooperative effort among Federal, state, and private agencies and organizations, and individual bird banders in North America to operate a continent-wide network of constant effort mist-netting stations to capture and band land birds and constant effort point count stations, during the breeding season (DeSante and Burton n.d.).

Regional or Statewide Studies Including FLW

A number of studies have been conducted by the MDC in the FLW region. Fisheries resources, endangered species monitoring, and natural features are well documented for this area. These projects also provide information regarding the natural resources occurring on FLW.

Missouri Natural Feature Inventory of Laclede, Phelps, and Pulaski Counties (Ryan 1992). Systematic inventory documenting and rating occurrences of natural communities, rare and endangered plants and animals, relict species sites, and geologic and other unique features. Field work in these three counties was completed in 1990-1991.

Gray Bat Cave Survey Report (McGimsey and Johnson 1994). Statewide survey of infrequently surveyed transient and maternity gray bat caves, including several gray bat caves on FLW.

Breeding Bird Atlas Project (Jacobs unpub.). Statewide standardized survey documenting breeding birds in Missouri. Several blocks were on FLW or nearby; one survey block was located in the center portion of FLW, a second block on the northwest boundary, and a third block southeast of FLW.

Fishery Resources of the Big Piney River and Gasconade Basin (MDC-Fisheries Division). Over the years, several studies documenting fish and other aquatic resources of Big Piney River have been completed. These surveys were primarily directed at game fish; however, information was often gathered describing non-game species as well. The study area is generally well described, offering a picture of current habitat conditions. Although most of these projects did not include a sampling point on FLW, they do provide information on fish communities upstream and downstream from FLW.

Studies of the Bottom Fauna of Two South Central Missouri Streams, the Niangua River and the Big Piney River (Foster 1957). Compared physical and benthic fauna of two streams.

Some Limnological Characteristics of Six Ozark Streams (Clifford 1966). Reported on the physical, chemical, and biological conditions of six Ozark streams, one of which was the Big Piney River. Field work was conducted in 1961.

Missouri's Fishing Streams (Funk 1968). Provided basic information regarding stream flow, drainage area, and length of Missouri's streams.

The Fish Population in Big Piney River (Russell 1974). Used information from fish sampling in 1963-1972 and creel surveys to determine trends in fish populations, estimate standing crop of selected species, and evaluate the effect of the 12-in. length limit established in 1967 on the smallmouth bass population.

The Fishery of Big Piney River and the Effects of Stocking Fingerling Smallmouth Bass (Fleener, Funk, and Robinson 1974). Documents smallmouth bass production and populations of forage fish. Used information obtained from creel surveys and from fish population surveys conducted between 1951 and 1958.

Harvest of Fish from the Big Piney River (Fleener 1974a). Reports harvest information obtained from a quantitative creel census conducted between 1963 and 1972. Evaluated changes in smallmouth bass populations and harvest after 12-in. length limit was established in 1967.

Reproductive Success of Fishes in Big Piney River (Pflieger 1974). Described the production of young for large fishes, determined species composition and trends in abundance of forage fishes, and evaluated the effects of various physical phenomena and black-bass length on recruitment of smallmouth bass. Field surveys were conducted between 1963 and 1972.

A Study of Gigging in the Big Piney River (Fleener 1974b). Summary of a gigging census conducted between 1963 and 1972. Notes game fish taken by gigging.

Distribution, Status, and Life History of the Bluestripe Darter, Percina cymatotaenia (Pflieger 1984). Includes reports on fish surveys conducted upstream and downstream of FLW on Big Piney River and Roubidoux Creek. Sites were surveyed between 1974 and 1982 as part of a state-wide fish survey. Includes information on fish assemblages in these streams.

Summary

The reports, surveys, and monitoring programs listed in this section offer a wealth of information about FLW and the surrounding region. Well studied FLW resources include plants, wetland communities, birds, small mammals, caves, endangered bats, and timber resources (although not included in the review, extensive surveys of timber stand quality have been conducted on FLW). Additionally, information is available from public wildlife harvests on FLW.

However, information on certain groups occurring on FLW is lacking. MDC fish surveys generally avoided sampling the intermittent creeks and portions of Roubidoux Creek and Big Piney River located within FLW boundaries. Scant information was available on freshwater invertebrates both on FLW and in the surrounding streams. Additionally, very little information was available for amphibians and reptiles on FLW.

Objective 2a — Freshwater Mussel Surveys of Designated Stream Reaches

Twenty-seven species (including two subspecies) of unionid mussels and the introduced Asiatic clam were found during the survey of FLW. Freshwater mussels known to occur in Big Piney River and Roubidoux Creek are presented in Table 2. Representatives of all 27 species were found in Big Piney River and 15 species were found in Roubidoux Creek. Live specimens were found for 21 of the 27 mussel species in Big Piney River and for 9 of the 15 mussel species in Roubidoux Creek.

No living or dead freshwater mussels or Asiatic clams were found in the seven tributaries surveyed on FLW. Although several of these are spring-fed, in no case is the flow enough to produce a stream channel with flowing water throughout the year. Isolated pools occur, but these often have bedrock as a substrate, which is not a suitable substrate for freshwater mussels.

Prior to the present survey, mussel fauna of both Big Piney River and Roubidoux Creek had not been thoroughly surveyed. Twenty-two species (including 2 subspecies) and 12 species were known from Big Piney River and Roubidoux Creek, respectively (Table 2). The survey increased the known number of species present to 28 (Big Piney River) and 18 (Roubidoux Creek).

Based on recent (Oesch 1984) and prehistoric (Warren 1993) accounts, and counting Buchanan's (environmental services biologist, MDC, pers. comm.) records as new if not mentioned elsewhere in the literature, the present data represent 10 and 6 new unionid records for Big Piney River and Roubidoux Creek, respectively. New records for Big Piney River include: threeridge, spectaclecase, purple wartyback, yellow sandshell, fragile papershell, threehorn wartyback, Ouachita kidneyshell, pimpleback, pistolgrip, paper pondshell. New records for Roubidoux Creek include: mucket, spectaclecase, purple wartyback, pink heelsplitter, monkeyface, and pistolgrip. The Asiatic clam is a new record for both streams.

Another species possibly occurring in both streams, and constituting new stream records, is the Ozark pigtoe. With the exception of one record, this species is restricted to south flowing Ozark streams. Live specimens similar to this species were found in both Big Piney River and Roubidoux Creek. Additionally, the Ozark pigtoe was documented (although identification is questionable) from Big Piney River by Johnson (1980). However, voucher specimens from this survey (like Johnson's), could not be positively identified for lack of living tissue. Additional specimens should be collected to determine the status of this species in Big Piney River and Roubidoux Creek.

Due to the occasional difficulty in determining the identity of northern broken-ray (*Lampsilis reeviana brittsi*) and Ozark broken-ray (*L. r. brevicula*) specimens, the two species were grouped together and are referred to only as *L. reeviana*. Although 28 species are known to occur in the Big Piney River, for purposes of this report the number is considered to be 27.

Eight species of unionids are endemic to the Ozarks (Johnson 1980). Specimens of two, Ouachita kidneyshell and *L. reeviana*, and possibly a third (Ozark pigtoe) were collected during this survey.

In southern Missouri, the Ozark crest separates river drainages North to South, with rivers on the northern slope flowing north, and rivers on the southern slope flowing south (Bretz 1965; Thom and Wilson 1980). The unionid fauna of the southern slope is richer in endemic unionid taxa than the northern slope (Johnson 1980), perhaps an artifact of more extensive surveys. Big Piney River and Roubidoux Creek have mussel fauna typical of the north flowing streams (Johnson 1980).

The Big Piney River and, to a lesser extent, Roubidoux Creek have relatively diverse mussel faunas. Unionid species richness in the Big Piney River is at least 2/3 of that in the Gasconade River. The Gasconade River has 40 species of freshwater mussels, including taxa found at archaeological sites on the river (Oesch 1984), to which Big Piney River and Roubidoux Creek are tributaries. The richness of endemic Ozarkian species in the Big Piney River is similar to other rivers on the northern Ozark slope, but not as high as that documented from the southern slope.

Big Piney River

Fourteen of the 42 mussel sampling sites on Big Piney River are located within the boundaries of FLW (Table 3). Excluding the Asiatic clam, only 20 of the 27 species were found within the boundaries of FLW. The seven mussel species not found on FLW are elktoe, slippershell mussel, fragile papershell, black sandshell, threehorn wartyback, Ouachita kidneyshell, and squawfoot. These species are uncommon in Big Piney River and with the exception of elktoe and black sandshell, all are known from the river only by a couple of weathered shells. Of the 20 species found on FLW, live specimens were found for 17 species and weathered shells for 3 species.

Our observations of dead individuals and counts of live individuals, show that the mucket is by far the most abundant and frequently encountered species in Big Piney River (Table 4). This species was encountered at 31 of 42 sampling locations and accounted for approximately 53 percent of all live specimens. Other relatively

abundant species were threeridge, monkeyface, ellipse, *Lampsilis reeviana*, and fatmucket. The most frequently encountered mussels in the Big Piney River were, in order of frequency, mucket, ellipse, Wabash pigtoe, and *L. reeviana*. Conversely, five species were found at only one sampling site, and each species was represented by one weathered shell. These species are yellow sandshell, fragile papershell, threehorn wartyback, Ouachita kidneyshell, and paper pondshell. Two other species, elktoe and squawfoot, were collected at two sites and were represented by one live mussel and two weathered shells at one site, and one weathered shell at the other site.

After the first sampling period in 1993, it was noted that species richness appeared greater in segments of Big Piney River upstream and downstream of FLW (Sternburg 1994). Additional sampling supported this observation. The number of native mussel species (live and dead) found at each sampling site was greater for sites off of FLW than for sampling sites on FLW. Sites 1–6 and 35–42 (excluding Site 38, which is in Spring Creek) averaged 13.9 species/site, and Sites 7–34 (excluding Sites 8–11, which were sampled as part of fish surveys and were not thorough samplings) averaged 7.6 species/site.

The greatest level of freshwater mussel species richness on FLW occurred at Site 28 (Table 3). A total of 15 mussel species was found from the backwater and river areas of this site, representing a unique assemblage of mussels compared to other sampling sites. Aerial photos from the 1930s show a backwater area, but much smaller than it is today. The construction of a dam in 1953 to provide deeper water for a float bridge training site upstream likely influenced water levels in this backwater area. The backwater area has practically no flow and a substratum consisting of silt, sand, and mud. Four species of unionid mussels that prefer a soft substratum were found at this site, including giant floater, pondmussel, paper pondshell, and yellow sandshell. The latter two species were found only at this site. Although several of the 15 species were located in other parts of the river, this site appears to serve as a refugia in a gravel/rock-dominated stream for species that require a soft substrate.

Additionally, greater abundance of freshwater mussels were found off of FLW. Although more locations on segments of Big Piney River were sampled within FLW than outside of its boundaries, 28 versus 14, approximately 1,400 more live mussels were found off of FLW (Table 4). Much of this disparity is due to having found three relatively large and diverse mussel beds upstream (Sites 2 and 5) and downstream (Site 36) of FLW. A total of 427 live mussels were found within the boundaries of FLW. Most of the live specimens found within FLW were at Site 28 (East Gate dam backwater) and Site 33 (below East Gate dam).

Roubidoux Creek

Two of the 13 mussel sampling sites on Roubidoux Creek are not within the boundaries of FLW (Table 5). Representatives of the Asiatic clam and all 15 mussel species found in Roubidoux Creek were found on FLW. Live specimens were found for nine freshwater mussel species and the Asiatic clam, and weathered shell was found for six species in Roubidoux Creek on FLW (Table 6).

Due to the losing nature of Roubidoux Creek, much of the stream is inhospitable to freshwater mussels. Specimens were found at 11 sites within FLW (Table 5). However, not included here are the many areas where there were no signs of mussel life, including weathered shells. Species richness was low, with an average of 6.08 species/sampling site and a total of 159 specimens observed (including two suspected Ozark pigtoes). Seven of the 13 sampling sites had 5 or fewer freshwater mussel species.

The most abundant species in Roubidoux Creek were spike, *Lampsilis reeviana*, and ellipse (Table 6). These three species accounted for approximately 71 percent of all living specimens found in this creek. The most frequently encountered species were *L. reeviana*, fatmucket, spike, and Wabash pigtoe.

Listed Freshwater Mussel Fauna

Prior to field surveys, it was determined that two Federally and/or state-listed species of freshwater mussels potentially occur in Big Piney River and/or Roubidoux Creek:

1. Elktoe; Federal–formerly C2; MO–Status Undetermined
2. Spectaclecase; Federal–formerly C2; MO–Watch List.

Representatives of both species were found in Big Piney River and Roubidoux Creek (Figure 4). In addition, one weathered shell of Ouachita kidneyshell was found in the Big Piney River. This species was formerly listed as a C2 species, and is currently considered a Watch List species in Missouri. Therefore, 3 of the 28 unionid species known to occur in the Big Piney River and/or Roubidoux Creek are of conservation concern. Locations for all occurrences are presented in Table 7. See **Listed Freshwater Mussels Species Accounts** for information on each listed species found during this survey.

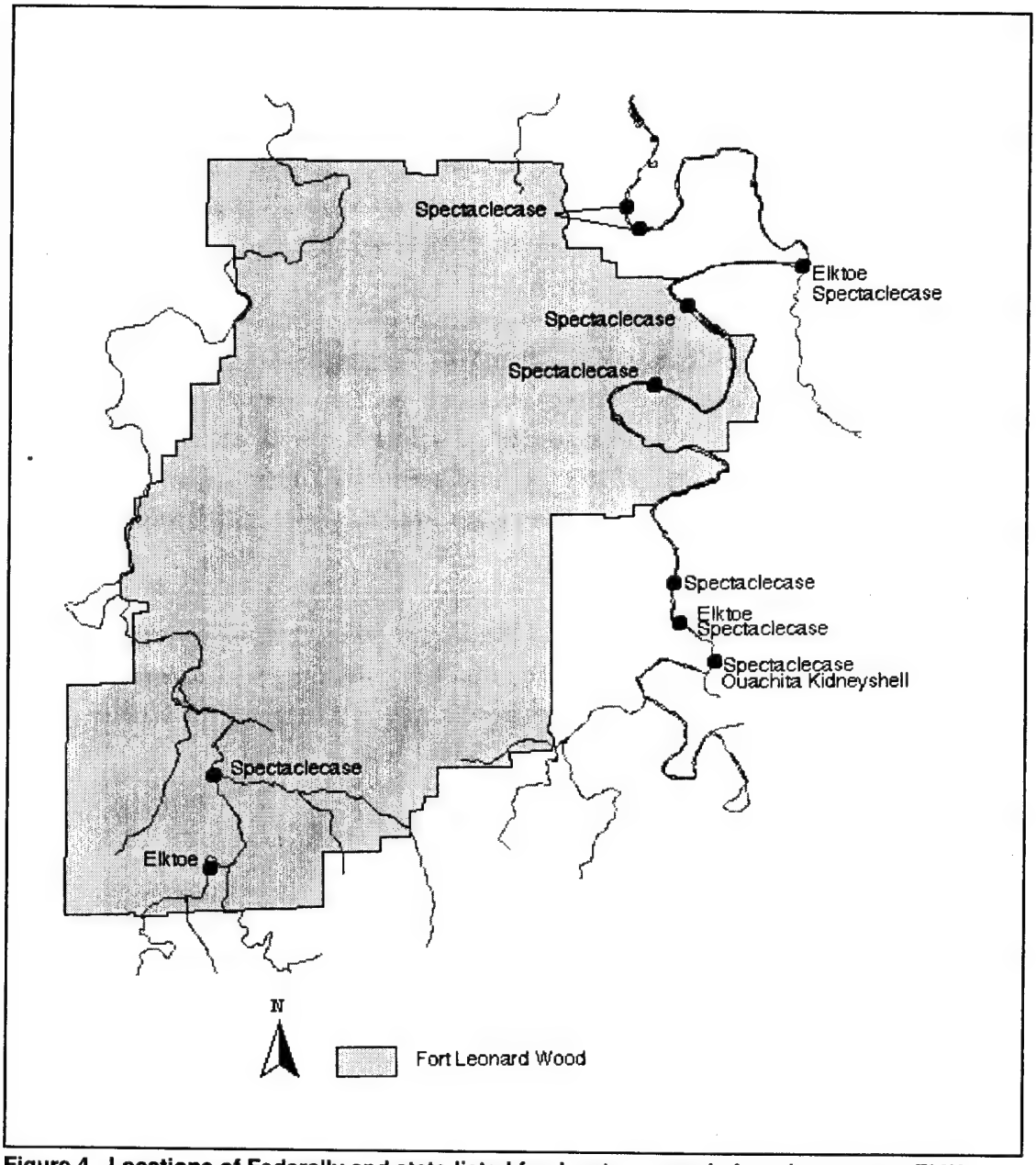


Figure 4. Locations of Federally and state-listed freshwater mussels found on or near FLW.

Although substrate appeared suitable for Federally and/or state-listed species known to occur in Big Piney River and Roubidoux Creek, few examples of these species were found during the survey. Two live elktoes were located during the present survey, one in Roubidoux Creek on FLW, and the other in Big Piney River upstream of FLW. Both live specimens were found in sandy, small- to medium-sized gravel substrate.

Live spectaclecase were not observed within FLW in either Roubidoux Creek or Big Piney River. However, shells were found at two sites within the FLW portion of Big Piney River and at one site within FLW on Roubidoux Creek. Locations of these

shells indicate that the species occurs, or at one time occurred, either upstream or near the site. Live spectaclecase were found several miles downstream of FLW (at Devil's Elbow, and below Interstate 44) in Big Piney River. Surveys directed at this species on areas within FLW that appeared to be suitable habitat were unsuccessful.

One weathered Ouachita kidneyshell was found at Ross Bridge on Big Piney River. Positive identification of this shell was not made until after surveys were complete, and it was a surprise to find this species in Big Piney River. Although never common, this species is more prevalent in streams flowing south off of the Salem Plateau (Oesch 1984).

Listed Freshwater Mussels Species Accounts

Elktoe (Federal–formerly C2; MO–Status Undetermined)

Survey results: One individual was found in Roubidoux Creek on FLW and one mussel was found upstream of the boundaries of FLW in Big Piney River. This species was not known from these streams until this survey. Mussels were found in sites with swiftly moving water, a gravel to sandy substrate, with depths ranging from less than 1 ft (Roubidoux Creek) to 3 ft (Big Piney River).

Previous sightings on FLW: None.

General habitat: May be found in small streams to large rivers, usually in areas with sand to gravel and cobble substrates (more often the latter) in water less than 2 ft deep (Buchanan 1980).

Missouri distribution: The elktoe may be found in most of the rivers draining the Springfield and Salem plateaus. It has also been found in two Mississippi River tributaries: the Salt River and the Cuivre River (Oesch 1984). Elktoes were common in the Big, Bourbeuse, and Meramec rivers in the Meramec Basin (Buchanan 1980).

Natural Heritage Database information: Aside from the records from the FLW study, only one other elktoe record exists in the Database; this record is from the Gasconade River.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure. The American Fisheries Society (Williams et al. 1993) considers this a species of Special Concern

(i.e., may become Endangered or Threatened by relatively minor disturbances to its habitat, and deserves careful monitoring of its abundance and distribution).

Comments: This species has never been common; future statewide mussel surveys will help in determining its conservation status.

Management recommendations: Improve existing riparian habitat to minimize erosion and siltation. Avoid in-stream activities that require or cause substrate disturbance, thereby increasing substrate instability.

Spectaclecase (Federal–formerly C2; MO–Watch List)

Survey results: Live specimens were not discovered within the boundaries of FLW, although two large populations of this species were found several miles downstream of FLW in Big Piney River. One site had 57 spectaclecase (at Devil's Elbow) and the other site below the I-44 bridge had 250 spectaclecase. Weathered shell was found at several locations on FLW in both the Big Piney River and Roubidoux Creek. These records indicate the species may occur within the boundaries of FLW in both streams.

Previous sightings on FLW: None.

General habitat: Species found in medium to large rivers with swiftly flowing water; large numbers often wedge into rock crevices, along the bank side, in deep water, 5 to 10 ft deep (Oesch 1984).

Missouri distribution: Primarily in the medium to large rivers of the Gasconade, Meramec, and Osage drainages (Buchanan 1980).

Natural Heritage Database information: The NHD contains 59 records of this species in Missouri. Live specimens were found at 31 of the 59 sites, and most sites had 10 or fewer live individuals.

Rangewide status: Widely distributed but absent from many areas where it formerly occurred. The Nature Conservancy ranks this as a G2/G3 species, indicating that globally populations are imperiled to rare or uncommon. The American Fisheries Society (Williams et al. 1993) considers this species Threatened (i.e., likely to become Endangered throughout all or a significant portion of its range). It is thought to be extirpated from Ohio and possibly Indiana (Cummings and Mayer 1992).

Comments: Of the two sites with large populations, all of the specimens found appeared to be adults, and fairly old. No young mussels were observed. Reproductive status of this species should be evaluated at these sites to determine population viability.

Management recommendations: Improve existing riparian habitat to minimize erosion and siltation. Avoid in-stream activities that require or cause substrate disturbance, thereby increasing substrate instability.

Ouachita kidneyshell (Federal–formerly C2; MO–Watch List)

Survey results: Although not thought to occur in either Big Piney River or Roubidoux Creek, one very weathered shell was found near the Ross Bridge river access, upstream of FLW.

Previous sightings on FLW: None.

General habitat: Medium-sized rivers with a substrate of gravel-mud and gravel and a moderate current (Oesch 1984). Generally found in shallow water riffles.

Missouri distribution: With the exception of several records for streams flowing north off of the Salem Plateau (Meramec, Niangua, and Sac rivers), this species is most often found in streams flowing south off the Salem Plateau (Oesch 1984). Where found, it is never abundant.

Natural Heritage Database information: The NHD contains nine records of this species in Missouri; each site had one to three live individuals.

Rangewide status: The Nature Conservancy ranks this as a G3/G4 species, indicating that globally populations are rare or uncommon to widespread, abundant, and apparently secure, but with cause for long-term concern. The American Fisheries Society (Williams et al. 1993) considers this species Threatened (i.e., likely to become Endangered throughout all or a significant portion of its range).

Comments: This species burrows into the substrate (Oesch 1984) and thus, may often be overlooked during surveys.

Management recommendations: Improve existing riparian habitat to minimize erosion and siltation. Avoid in-stream activities that require or cause substrate disturbance, thereby increasing substrate instability.

Objective 2b — Crayfish Surveys of Designated Stream Reaches

The crayfish fauna in the streams of FLW is not diverse. Two common species were identified during fish and mussel sampling: golden crayfish and spothanded crayfish. Individuals of both species were numerous in most of the streams sampled and numbers were not recorded. Both crayfish species were found in Big Piney River, Roubidoux Creek, East Gate Tributary, and the streams running through Musgrave Hollow, Turnbull Hollow, Ballard Hollow, and Falls Hollow. Neither species was found in the streams running through Hurd Hollow and McCann Hollow.

Another species of crayfish, Salem cave crayfish occurs in Roubidoux Spring at Waynesville. This is a Missouri-Watch List species. As Roubidoux Creek is a known recharge stream for Roubidoux Spring, it is possible that this species may occur in streams of caves associated with the Roubidoux Creek watershed. However, it has not been reported from caves on FLW (Oesch and Oesch 1986).

Another crayfish, the devil crayfish, is reported from southern Pulaski County (Pflieger 1996). This common crayfish has a statewide distribution, but appears to be absent from the southwest portion of the state. This burrowing crayfish is rarely seen as it spends most its life in underground burrows. However, the mud chimneys topping its burrows are readily identified. Burrows are constructed in timbered and formerly timbered areas along streams and ditches (Pflieger 1996). Although not observed during this survey, this species likely occurs on FLW.

Two other listed crustaceans are known from Pulaski County: (1) Central Missouri cave amphipod, Federal–formerly C2, MO–Rare; and (2) Onondaga cave amphipod, Federal–formerly 3C, MO–Watch List. Both species occur in a cave located directly west of FLW. The Central Missouri cave amphipod is known from one cave on FLW (Oesch and Oesch 1986).

Objective 2c — Fish Surveys of Designated Stream Reaches

Fish surveys of Big Piney River, Roubidoux Creek, and semi-permanent streams associated with Musgrave, Turnbull, Ballard, Falls, Hurd, and McCann hollows, and East Gate Road were conducted between April 1994 and October 1995. A total of 57 species representing 13 families of fish were collected or observed during this survey (Table 8).

Big Piney River

Sampling was done on 31 sites on Big Piney River, 25 of which occurred either within FLW, or along the installation's boundary. Fifty-one species from 12 families of fish were identified during sampling (Tables 9A-C). Two additional species of fish — mooneye and rainbow trout — were not collected during the survey process, but were observed from Big Piney River. A fisherman showed the researchers a mooneye he had just caught in Big Piney River, and rainbow trout are stocked in Stone Mill Spring Management Trout Area. Therefore, the total number of species and families identified during this study are 53 and 14, respectively.

The present researchers found a lower level of species richness in Big Piney River than did previous researchers (Table 8). This is explained primarily by the fact that fewer large game species were captured in the present survey. Fleener et al. (1974a) reported 70 species from 14 families occurring in Big Piney River upstream of Ross Bridge from surveys conducted in the 1950s (Table 8). Pflieger (1974) stated that 66 species from 15 families are known to occur in Big Piney River. Species not mentioned by Fleener et al. (1974a) but collected or observed during this survey include: rainbow trout, striped shiner, and mosquitofish. Species not mentioned by Pflieger (1974) but collected during this survey: mosquitofish.

Species richness in the stretch of the Big Piney River sampled, appears typical of that for a small river in the Ozark Faunal Region-Missouri Division (Pflieger 1989). Although few large game fish were collected in the present survey, this is primarily due to sampling methods.

Larger fish are best sampled using a boat rigged for electroshocking, and only 1 day was spent sampling with this method. As the primary objective of the fish survey was to document Federally and state-listed species, the study concentrated on habitats suitable for targeted listed species. Cyprinids dominated the catch in the Big Piney River, with Centrarchids and Percids also contributing much to species richness and abundance (Tables 9A-C). By far, the most common species was bleeding shiner, both in numbers and frequency of occurrence. Other well represented species included: striped shiner, Ozark minnow, largescale stoneroller, and wedgespot shiner.

According to Pflieger (1975) the striped shiner has inexplicably decreased in the Gasconade drainage (although not in other portions of its range) and is reported from only one collecting location on the upper portion of the Gasconade River. This species was the second most numerous species (369 individuals) in the present collection effort, and was present at 15 of the 31 sampling locations. Although fewer

than 10 specimens occurred at most sites, more than 50 individuals were collected at 4 of the 15 sites.

Roubidoux Creek

Sampling was done on 22 sites on stretches of Roubidoux Creek within FLW. Forty species representing eight families of fish were identified (Tables 10A-B). Fish occurring in Roubidoux Creek have not been as well documented as those in Big Piney River. By piecing together information from unpublished MDC Fisheries Research Fish Records and Pflieger (1975) it was determined that 45 species representing 9 families of fish are known to occur in Roubidoux Creek.

Species diversity in the stretch of Roubidoux Creek sampled appears typical of that for a creek/small river in the Ozark Faunal Region-Missouri Division (Pflieger 1989). As with collections from Big Piney River, not many of the larger game fishes were collected. Large suckers were extremely common, but very difficult to catch with a drag seine. Also, the focus was on documenting listed species, and most of the sampling effort was concentrated on habitat preferred by targeted listed species.

Cyprinids dominated the catch in Roubidoux Creek (Tables 10A-B). Cyprinodontids, Centrarchids, and Ictalurids also were a major portion of the catch. However, most Ictalurids were from one location and were recently hatched black bullheads. The most common species, based upon number and frequency of occurrence, are bleeding shiners, northern studfish, bigeye shiners, and longear sunfish.

Striped shiners were collected from 11 of the 22 sites, for a total of 161 striped shiners. This species reportedly has decreased in the Gasconade drainage, although not in other areas of its range (Pflieger 1975). Collecting this species from both Roubidoux Creek and Big Piney River, with relatively high frequency and number, is an interesting note.

Tributary Streams

Streams associated with six hollows (Ballard, Falls, Hurd, McCann, Musgrave, and Turnbull) and East Gate Road were sampled in their entirety in mid- to late-spring. With the exception of Falls and Musgrave hollows, all streams were sampled during a 1-day period. Twenty-six species from eight families of fish were identified from these seven streams. Table 11 shows the species and number collected.

Species richness of these tributary streams was typical for an Ozark Headwater stream of the Ozark Faunal Region-Missouri Division (Pflieger 1989). Fish communities are less diverse and species abundance is lower in headwaters than

creeks. Typical species in headwaters include: southern redbelly dace, creek chub, orangethroat darters, and stonerollers (primarily central stonerollers in headwaters; however, many largescale stonerollers were found in Ballard Hollow, just upstream of joining with Roubidoux Creek). Fish from Hurd Hollow 2 were in a small marsh-pond habitat that appears to receive overflow from Penns Pond. Sunfish were the most common fish at this site.

Listed Fish Fauna

Prior to field surveys, it was determined that five Federally or state-listed species of fish occur in Big Piney River and two occur in Roubidoux Creek (Fleener et al. 1974a; Pflieger 1974; Pflieger 1975). These are:

1. Mooneye; Big Piney River; MO–Rare
2. Highfin carpsucker; Big Piney River; MO–Rare
3. Plains topminnow; Big Piney River; Federal–formerly C2; MO–Status Undetermined
4. Blacknose shiner; Big Piney River and Roubidoux Creek; MO–Rare
5. Bluestripe darter; Big Piney River and Roubidoux Creek; Federal–formerly C2; MO–Rare.

Representatives of mooneye, plains topminnow, and bluestripe darter were found in Big Piney River; blacknose shiner was found in Roubidoux Creek; and plains topminnow was found in Falls Hollow Tributary (Figure 5; Table 12). Information on each listed species discovered during this survey is presented under **Listed Fish Species Accounts.**

Two of the five listed species known to occur in Big Piney River were not found during this survey. Pflieger (1975) states that the highfin carpsucker is largely confined to the Ozarks, where it is more common in larger reservoirs than in streams. Fleener et al. (1974a) reports catching eight highfin carpsuckers in the 1950s at a site on the lower portion of Big Piney River, several miles downstream of FLW. The other listed species not found in Big Piney River is the blacknose shiner, which is decreasing throughout the state (Bruenderman, fisheries research biologist, MDC, pers. comm.). Pflieger (1975) and the NHD (1980 record) report this species as occurring upstream of FLW, usually in small numbers. Further surveys may locate a few individuals within FLW boundaries. However, as the Big Piney River at this point is wider, with a deeper, swifter current, habitat conditions are not optimal.

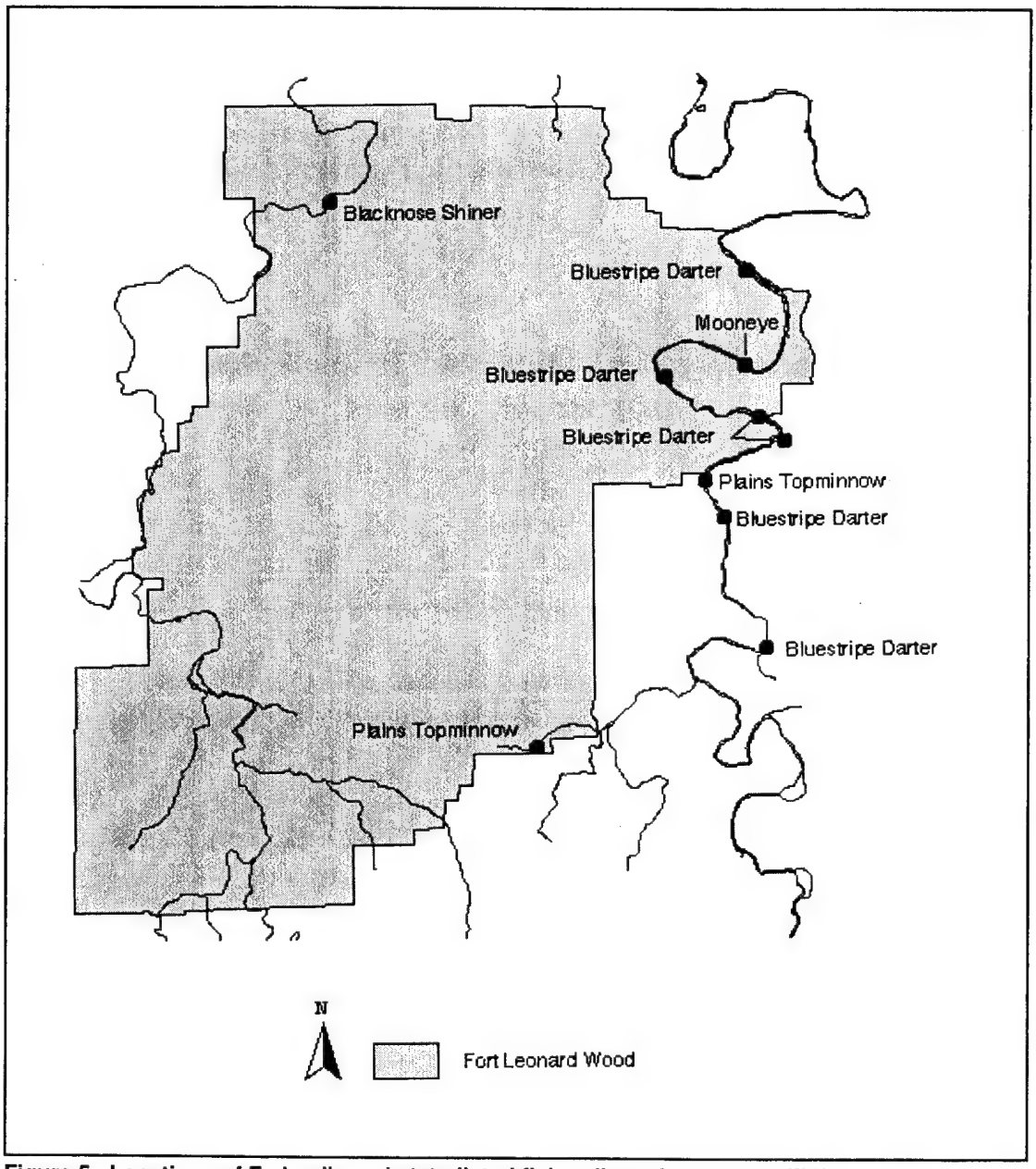


Figure 5. Locations of Federally and state-listed fish collected on or near FLW.

Bluestripe darters were not found during the survey of Roubidoux Creek. This species was collected from Roubidoux Creek upstream of FLW in 1980 (unpub. MDC Fisheries Research records). Much of Roubidoux Creek on FLW is a losing stream. As such, much of the creek within the installation is not suitable for many fish, including bluestripe darters.

Listed Fish Species Accounts

Plains topminnow (Federal–formerly C2; MO–Status Undetermined)

Survey results: The plains topminnow was found in two locations: Falls Hollow tributary of Big Piney River in FLW and just upstream of FLW's boundary on Big Piney River. The Falls Hollow specimen was in a small, clear, moderately deep pool (2 ft) in the small headwater creek, which drains into the Big Piney River. The Big Piney River specimen was caught along a sandbar, in a quiet, clear pool.

Previous sightings on FLW: None.

General habitat: This topminnow inhabits quiet, clear pools of small creeks, and backwaters and overflows of larger streams (Pflieger 1975). Cover in the form of nearby beds of submergent vegetation is often associated with sites.

Missouri distribution: This species appears to be restricted to the Gasconade, Osage, and Lamine River drainages, although a disjunct population is known from the Spring River drainage (Pflieger 1975).

Natural Heritage Database information: The NHD contains 64 records — 32 historic and 32 extant.

Rangewide status: The Nature Conservancy ranks this as a G4 species, indicating that globally it is widespread, abundant, and apparently secure, but with cause for long-term concern.

Comments: The last reported record of this species in the Big Piney River is from 1981.

Mooneye (MO–Rare)

Survey results: One fish was caught by a fisherman in Big Piney River along the FLW golf course. Generally a big river fish, it was an unexpected find in the portion of Big Piney River on FLW.

Previous sightings on FLW: None.

General habitat: This species is generally found in the larger pools of streams and the open waters of reservoirs (Pflieger 1975).

Missouri distribution: Statewide in larger rivers, with the exception of the southwest corner of the state (Pflieger 1975).

Natural Heritage Database information: The NHD contains 28 records for the mooneye in Missouri. These are primarily located in the Mississippi and Black rivers.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: Although it was reported to occur in Big Piney River (Fleener et al. 1974), the closest Heritage location is in the Gasconade River at the Fredericksburg Access.

Blacknose shiner (MO–Rare)

Survey results: One fish was found in an isolated pool on the losing portion of Roubidoux Creek in 1994.

Previous sightings on FLW: None.

General habitat: In the Ozarks, this minnow is found in quiet, heavily vegetated pools and in backwater areas of small rivers and creeks (Pflieger 1975).

Missouri distribution: Four disjunct populations are known. Loutre River and tributaries; Lamine River and tributaries; smaller creeks and rivers associated with the Osage River; and in streams associated with the Gasconade River (Pflieger 1975).

Natural Heritage Database information: The NHD contains 56 records for this species — 27 extant records, 26 historic records, and 3 records where the site was destroyed to make way for the Truman Reservoir.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that it is demonstrably widespread, abundant, and secure.

Comments: Prior to this survey, the last reported records for this fish in the streams surveyed for this study were from 1980 for the Big Piney River and from 1967 for Roubidoux Creek. A resurvey of Missouri fishes is in the final stages, and early reports indicate that numbers and range of the blacknose shiner have decreased considerably in the last 25 years (Bruenderman pers. comm.).

Bluestripe darter (Federal–formerly C2; MO–Rare)

Survey results: Bluestripe darters were found at five locations on Big Piney River; one location is represented by two occurrences for a total of six records. Three sites were within and two sites were outside of FLW's boundaries. Four of the six records were in areas typical of bluestripe darter habitat. However, two sightings were made in deeper (5 ft) and faster flowing water, over a sandy and boulder substrate.

Previous sightings on FLW: None.

General habitat: This darter tends to be found in quiet pools and backwaters with sandy bottoms and abundant cover, such as submergent vegetation or accumulations of sticks and leaves (Pflieger 1975, 1984).

Missouri distribution: Gasconade drainage and the Niangua River (Pflieger 1975, 1984).

Natural Heritage Database information: The NHD contains 41 records of the bluestripe darter in Missouri — 14 extant records and 17 historic records.

Rangewide status: The Nature Conservancy ranks this as a G3 species, indicating that globally it is rare or uncommon.

Comments: The last reports of this species in Big Piney River and Roubidoux Creek were made in 1981. As with the blacknose shiner, the numbers and range of this species are decreasing (Bruenderman personal communication).

Objectives 3a-b — Amphibian and Reptile Surveys

Based on available habitat on FLW, known ranges of species, and previous collections or observations in Pulaski County, a total of 68 species were identified as potentially occurring on FLW: 25 amphibian and 43 reptile species. A total of 566 individuals representing 21 amphibian species and 30 reptile species were found on FLW during this survey (Table 13). The survey found specimens representing eight new or updated Pulaski County records (Table 13). Voucher specimens will be deposited in the Natural History Museum at the University of Kansas, Lawrence.

Richness of amphibian and reptile species at FLW appears indicative of that occurring in the Upper Ozarks. Examples were not found of all 68 species thought possibly to occur on the installation. However, with the exception of several large snakes, no common, easily located species was absent from the survey findings.

Seventeen amphibian and reptile species thought to occur on FLW were not located during the survey.

Eight of the 17 amphibian and reptile species not found during this survey of FLW have been vouchered or observed in Pulaski County (Table 13) and presumably might be located on the installation with additional surveys concentrating on suitable habitats. These species include: eastern hellbender, mudpuppy, graybelly salamander, Missouri river cooter, western painted turtle, Great Plains rat snake, eastern coachwhip, and western cottonmouth. The remaining nine species, all with ranges including Pulaski County and FLW, are (like many amphibians and reptiles) shy species that often are not easily located. These species include: four-toed salamander, false map turtle, ornate box turtle, eastern collared lizard, western slender glass lizard, northern scarlet snake, bullsnake, rough earth snake, and timber rattlesnake. Additionally, several of these species are rare to uncommon in the state, making location difficult.

Listed Amphibians and Reptiles

Based on available habitats, reported species' ranges, and previous collections or observations, six species of amphibians and reptiles of conservation concern were identified as potentially occurring on FLW:

1. Eastern hellbender; Federal– formerly C2; MO–Watch List
2. Ringed salamander; MO–Watch List
3. Four-toed salamander; MO–Rare
4. Grotto salamander; MO–Watch List
5. Northern scarlet snake; MO–Rare
6. Eastern collared lizard; MO–Watch List.

Special habitat searches were directed at listed species and conducted at 30 stations on FLW. Effort spent at each location varied with weather, size of area to be surveyed and number of available personnel. No Federally listed species, or species with a state designation of Rare or Endangered, were located during this study. Specimens of two state Watch Listed species were found on FLW. One specimen, the grotto salamander, was located during the special habitat search. The second, the ringed salamander, was found in terrestrial funnel traps.

Thus, two of the 51 amphibian and reptile species occurring on FLW are of conservation concern. Figure 6 is a map showing approximately where the species were found. More detailed location information for each listed species' occurrence is presented in Table 14, and both species are discussed in **Listed Amphibian and Reptile Species Accounts** later in this chapter.

The possibility exists that other listed species will be found on FLW, because suitable habitat is available for some of these species and failure to locate them does not mean they are not present. A description of the four potentially occurring listed species not found during this survey follows.

Eastern hellbender. Although FLW is well within the eastern hellbender's range, which includes rivers flowing north off the Ozark Plateau into the Missouri and Mississippi rivers (Johnson 1992), this species was not found in Big Piney River or Roubidoux Creek during this survey. Portions of Big Piney River on FLW provide only marginal habitat for this species (Fobes, graduate student, Southwest Missouri State Univ., pers. comm.). Big Piney River on FLW is fairly turbid and without the

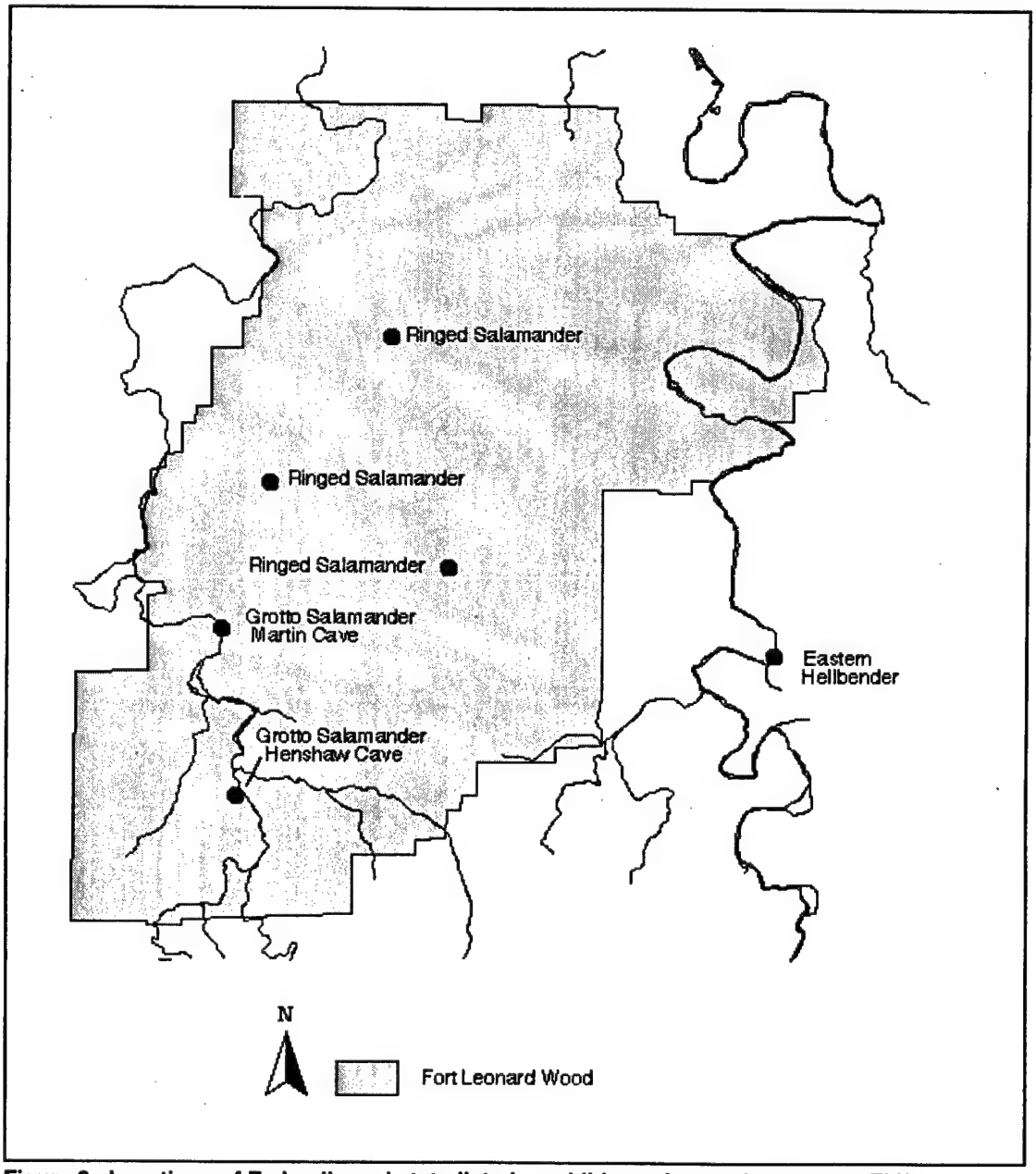


Figure 6. Locations of Federally and state-listed amphibians observed on or near FLW.

large flat rocks needed for cover. Much of Roubidoux Creek on FLW is a losing stream and, as such, is not favorable habitat for the eastern hellbender (Johnson, herpetologist, MDC, pers. comm.). Suitable habitat for the eastern hellbender consists of cool waters of rocky, clear, fast-flowing rivers and streams (Nickerson and Mays 1973). However, six eastern hellbenders were caught near Ross Bridge on Big Piney River by MDC Fisheries personnel. Additionally, unverified anecdotal reports of eastern hellbenders occurring in the Big Piney River on FLW exist.

Four-toed salamander. The four-toed salamander is very secretive and difficult to locate. Although this species was not found on FLW, it has been found on Mark Twain National Forest, less than 15 miles from the eastern boundary of FLW (Missouri NHD). There are two ways of locating this species: (1) look for females with eggs in mossy areas along heavily forested, spring-fed creeks or sinkhole ponds in early to mid-March, or (2) use drift fencing and pit-fall traps in forested uplands (Johnson 1992). Due to labor constraints, the former method was used to try and locate this species. Very few areas on FLW had suitable habitat, and what was available was marginal. Most of the mossy beds that were located along upland creeks were very small, and not very dense.

Northern scarlet snake. An unverified report of a northern scarlet snake near open landfills in the northern portion of FLW was made several years ago by an amateur herpetologist (Johnson pers. comm.). These landfills have since been closed and covered with soil. Surveys for the northern scarlet snake on FLW were unsuccessful. This is a secretive snake that is rarely observed. It is presumed to occur in south-central Missouri in the Ozark Natural Division, and possibly could occur on FLW (Johnson pers. comm.).

Eastern collared lizard. The eastern collared lizard is most often found under large, flat rocks on dry limestone or sandstone glades facing south to southwest (Johnson 1992). It is found throughout the Missouri Ozarks and on the glades of the St. Francois Mountains. Most of the glades on FLW appeared to have more vegetation and soil cover than those glades most often associated with the eastern collared lizard. Small segments of certain glades on FLW appeared suitable; however, searches of these areas for the collared lizard were unsuccessful.

Capture Methods and Results

In addition to the special habitat search for listed species, a number of other methods were used to search for amphibian and reptile species. A brief description of the results of each method follows. A list of all species captured on FLW is found in Table 13. Table 15 shows names and numbers of species found by each survey

method. For more detailed information on survey results, see Sanborn and Sternburg (1996).

Road cruise. Eighty-four amphibians and reptiles, representing 11 species of amphibians and 1 species of reptile, were observed during night road cruises. These surveys were conducted during heavy thunderstorms in mid-May 1995 on two roads (FLW Roads 25 and 26) running parallel to the Big Piney River. One species identified, the marbled salamander, represented a new Pulaski County record.

Frog and toad breeding call survey. Frog and toad breeding call surveys were attempted between 7 April and 12 July 1994 and 29 March and 27 July 1995. However, due to weather and other extenuating factors, several surveys were not completed for all 10 stations. Ten species of frogs and toads were heard calling during the breeding call surveys. No more than nine species were heard in any 1 year, and the eastern narrowmouth toad was not heard in 1994 or 1995.

Terrestrial funnel trapping. A total of 105 specimens were captured and identified by terrestrial funnel trapping; these represented seven and eight species of amphibians and reptiles, respectively. Three juvenile ringed salamanders, a Missouri Watch-List species, were caught, all in the same general area of FLW. Additional searches of these areas for ringed salamanders were unsuccessful. Both the broadhead skink and western earth snake were new Pulaski County records.

Aquatic funnel trapping. Turtle traps were set in 1995 at three sites representing different habitat types on FLW. In the course of 3 trapping sessions, 103 specimens of 3 species of turtles were captured and identified: red-eared slider (62), common musk turtle (34), and common snapping turtle (7). A voucher of the red-eared slider, a new Pulaski County record, was collected and deposited in The Natural History Museum at the University of Kansas, Lawrence.

No additional aquatic funnel trapping was attempted, as no further species were being located and it is a very time-consuming search method. Further observations of turtles were made by locating turtles basking on logs along the Big Piney River and Roubidoux Creek and identifying them with the aide of binoculars and a spotting scope. These are recorded as incidental observations.

Terrestrial time search. Terrestrial time searches were conducted at 16 stations on FLW during this study. Seventy specimens of 8 species of amphibians and 16 species of reptiles were collected and identified.

Aquatic time search. Three aquatic time searches were conducted, but no additional species were identified, so this survey method was discontinued. Five amphibian species were collected and identified.

Cave surveys. Ten wet caves on FLW were identified and searched for amphibians and reptiles in 1995. Five species of amphibians and one species of reptile were located during these searches. Additional surveys may locate graybelly salamanders.

Incidental Observation. A total of 177 individuals, representing 14 species of amphibians and 22 species of reptiles, were captured and identified incidentally to other surveys on FLW. One listed species, ringed salamander, was found by this method. Voucher specimens of two new Pulaski County records, the eastern hognose snake and rough green snake, will be sent to the Natural History Museum at the University of Kansas, Lawrence.

Listed Amphibian and Reptile Species Accounts

Ringed salamander (MO–Watch List)

Survey results: Ringed salamanders, all juveniles, were captured from three areas on FLW: LCTA plots #47, #316, and #324 located in dry-mesic upland forest, and the foxholes on Range 12.

Previous sightings on FLW: None.

General habitat: This salamander is very secretive and little is known of its habits. The ringed salamander is generally found hiding under logs and rocks or burrowing in the soil. It seldom ventures into the open and prefers heavily forested areas (Johnson 1992).

Missouri distribution: Ringed salamanders occur in the southwestern and central portions of the Missouri Ozarks and in the river hills of the Missouri River in the eastern section of the state (Johnson 1992).

Natural Heritage Database information: The NHD contains 20 records of ringed salamanders in MO — 10 extant and 10 historic. Ringed salamanders have been found at two locations within 15 miles of FLW.

Rangewide status: The Nature Conservancy ranks this as a G4 species, indicating that globally it is widespread where it occurs (i.e., Ozarks), abundant, and apparently secure, but with cause for long-term concern.

Comments: None.

Grotto salamander (MO–Watch List)

Survey results: This salamander (both adult and larvae) was found in two wet caves, Martin and Henshaw, on FLW.

Previous sightings on FLW: Henshaw Cave (Oesch and Oesch 1986). A 1941 record from Martin Cave (=Maxey Cave?) is in error. This species was found in nearby Great Spirit Cave, which has also been known as Maxey Cave.

General habitat: Grotto salamanders are found in wet, Ozark Plateau caves with a spring or stream (Johnson 1992).

Missouri distribution: Karst regions of the Ozark Plateau (Johnson 1992).

Natural Heritage Database information: The NHD contains 66 records of the grotto salamander in Missouri — 47 extant and 19 historic. Several records are known from caves in Pulaski County.

Rangewide status: The Nature Conservancy ranks this species as a G4 indicating that globally it is widespread where it occurs (i.e., Ozarks), abundant, and apparently secure, but with cause for long-term concern.
Comments: Grotto salamanders are often found in greater abundance in caves that have a large number of bats, possibly due to the presence of insects attracted to bat guano (Johnson pers. comm.).

Objective 4 — Resident and Migratory Bird Surveys

The main objective of these surveys was to document Federally and state-listed species of birds on FLW. A secondary objective was to identify neotropical migrants and gain an understanding of their occurrence on FLW. As the field work required to complete the secondary objective was beyond the scope of this project, and data are available from an ongoing mist net and point count survey on FLW (MAPS), it was decided to concentrate field efforts on listed species. Information from the MAPS study was useful in describing species use of various habitats on FLW.

Birds on FLW

During 1994-1995, 114 species representing 32 families of birds were identified on FLW (Table 16). Records from FLW indicate that 193 species of birds have been positively identified and the Bachman's sparrow tentatively identified, for a total of 194 species on the installation (Proffitt 1994). The study added three new species to the installation list: great egret, marsh wren, and sedge wren. The 1995 MAPS study added common moorhen to the installation list (MAPS unpub. data). These records give a total of 197 species of birds positively identified and one species tentatively identified on FLW. One species included in Table 16, but not observed on FLW, is the blue grosbeak. This species was located directly west of FLW during 1989 Breeding Bird Atlas surveys, and is likely to occur on FLW.

Based on observational and physiological evidence (DeSante, Walker, and Burton 1994; MAPS unpub. data), breeding status was determined for most species observed on FLW (Table 17). Reproductive status was confirmed for 66 species, deemed probable for 3 species, and thought possible for 41 species. Eighty-eight species are known to be transients on FLW or are species for which breeding status could not be determined.

A total of 144 species of neotropical migratory birds is known to occur on FLW (Table 16). Reproductive status for these species on FLW was confirmed for 45 species, deemed probable for 3 species, and thought possible for 30 species. These figures indicate that approximately 51 percent of the neotropical migratory bird species known to occur on FLW also are reproducing on the installation. Most of the neotropical migrants that do not nest on FLW are waterfowl, shorebirds, and warblers, whose breeding ranges are north of Missouri. Other species require large, emergent wetlands, which are unavailable at FLW.

Data from the ongoing MAPS study (DeSante, Walker, and Burton 1994; MAPS unpub. data) provide an indication of bird species abundance on FLW. Since 1993, point counts and mist netting surveys have been conducted by MAPS personnel on FLW. Six stations were established in an attempt to document bird populations from available habitats (Table 18). Ten mist net sites and nine point count sites were established at each station, and surveys were conducted between late May and early August.

Based on 1993 and 1995 MAPS survey results (DeSante, Walker, and Burton 1994; MAPS unpub. data), the 10 most abundant species (accounting for more than 80 occurrences by either mist-net or point-count surveys) on FLW are shown in Table 19.

Species most adapted to open, brushy areas and forest edge dominated the MAPS results in 1993 and 1995 (i.e., indigo bunting, blue-winged warbler, American crow, northern cardinal, field sparrow, yellow-breasted chat, brown-headed cowbird, and eastern towhee). The red-eyed vireo was the only species preferring large tracts of mature forest that was among the 10 most abundant species in both years. Whether these results are an artifact of sampling due to station placement, or a true representation of species abundance on FLW, cannot be determined based on this limited amount of sampling.

However, a comparison of MAPS data on FLW to unpublished point-count data from the surrounding Mark Twain National Forest, also indicates that FLW appears to have greater numbers of bird species that prefer forest edge and brushy areas than does the surrounding Mark Twain National Forest (USFS, Mark Twain National Forest, unpub. data). Species more adapted to forest interior were more abundant on Mark Twain National Forest than on FLW (i.e., red-eyed vireo, ovenbird, black-and-white warbler, and summer tanager).

Much of the forested landscape of FLW is fragmented due to past land-use patterns before the establishment of FLW and to the necessary fire management techniques implemented on training ranges. Fire breaks are necessary to contain fires started by exploding ordnance; however, this form of habitat manipulation creates more edge, reducing the amount of contiguous woodland and leads to habitat fragmentation. Bird species requiring extensive wooded tracks are negatively impacted by forest fragmentation. However, those species that prefer edge and scrubby habitat benefit from forest fragmentation.

It is believed that forest fragmentation, favorable for cowbirds, is a factor in the decline in numbers of neotropical migratory birds, as many neotropical migrants are forest interior birds. Nest parasitism by brown-headed cowbirds is a threat to neotropical migrants on their breeding grounds. The greatest number of brown-headed cowbirds observed or mist netted on FLW during MAPS sampling occurred in 1993, with 107 brown-headed cowbirds observed during point counts (DeSante, Walker, and Burton 1994). Fewer cowbirds were observed in 1994 (8) and 1995 (24). The greatest number occurred in those areas with mixed habitats (Big Piney River area, Laughlin Bottoms, Miller Pond). However, approximately, 20 percent of the brown-headed cowbirds observed in 1993 were observed at Miller Ridge, an area described as mature deciduous forest. The presence of brown-headed cowbirds indicates this area is not entirely forested, and open areas are present.

According to Robbins and Easterla (1992), several bird species preferring *Pinus echinata* have declined in Missouri, primarily due to loss of this habitat. *P. echinata* is available on FLW in small native stands along Roubidoux Creek and Big Piney

River, as well as in approximately 2,000 acres of pine plantation planted in the late 1950s and 1960s. Three species associated with this community that have declined in number were observed in low numbers on FLW (Table 16). Pine warblers were observed at each of six point-count locations (PCLs) in 1993-1995 (DeSante, Walker, and Burton 1994; MAPS unpub. data). Chipping sparrows were observed at one PCL in 1993 and two locations in 1994. The yellow-throated warbler, which is primarily associated with riparian forest but also occurs in *P. echinata*, was identified at two PCLs and one mist-net location (MNL) out of six in 1993 and one PCL in 1994 and 1995.

Bird species associated with riparian forests have also declined throughout the state, primarily due to loss of wooded stream banks. Species associated with riparian areas observed on FLW that have suffered statewide declines include: Acadian flycatcher, warbling vireo, yellow-throated warbler, cerulean warbler, American redstart, prothonotary warbler, and hooded warbler (Robbins and Easterla 1992). Riparian forests along the large streams on FLW are relatively extensive. Current management strategies of avoiding training activities and timber harvests along stream banks have helped improve the quality of these riparian areas.

Fort Wood also provides upland forested habitat, and a number of species that have declined in Missouri and are associated with these areas were found on FLW. These species include pileated woodpecker, eastern wood-pewee, wood thrush, red-eyed vireo, black-and-white warbler, worm-eating warbler, ovenbird, and Kentucky warbler. Three of these species, red-eyed vireo, ovenbird, and Kentucky warbler, were quite common and were often observed during MAPS point counts or mist-net surveys (DeSante, Walker, and Burton 1994; MAPS unpub. data).

Listed Bird Fauna

Based on known occurrences in the area, survey efforts were concentrated on 14 Federally and/or state-listed bird species thought possibly to have a breeding population on FLW and one great blue heron rookery (Table 20).

Over the 2-yr period and during the accepted breeding season (noted by the Breeding Bird Atlas study) for each species, 8 of the 14 listed species on FLW were identified (Table 20). Five listed species thought not to reproduce on FLW were observed during spring or fall migration: great egret, osprey, marsh wren, chestnut-sided warbler, and pied-billed grebe. Locations of each sighting are presented in Figure 7 and Table 21. Information regarding each listed bird species observed during this study is presented under **Listed Bird Species Accounts**.

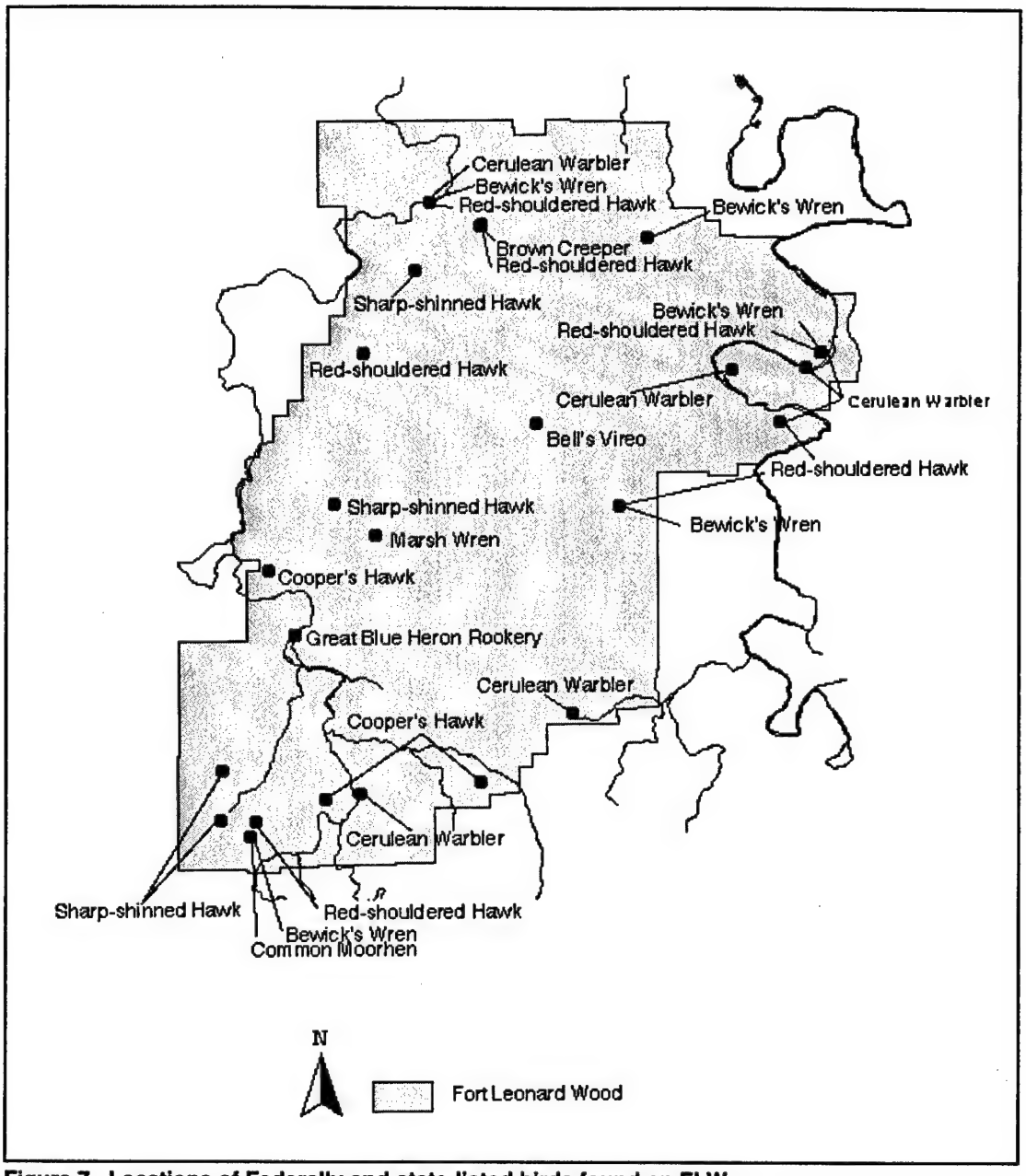


Figure 7. Locations of Federally and state-listed birds found on FLW.

Although not observed during this study, Bachman's sparrow (Federal–formerly C2, MO–Endangered) was reported from FLW on LCTA plot #53 in late May 1990, and a questionable sighting was made in 1992 near Ranges 28 and 29. Both observations occurred in open areas with herbaceous growth. This species nests in open pine woods with a grassy understory or in old fields with scattered shrubs (Harrison 1975), and it has been known to nest on glades with a relatively dense herbaceous cover in southern Missouri (Hardin, Baskett, and Evans 1982). Robbins and Easterla (1992) consider this species a very rare and local summer resident in the Ozarks and at least formerly in the Ozark border. Bachman's sparrow was previously more widespread, and decline may be due to succession of primary habitat. Before settlement, it was probably most common in the *Pinus echinata*

areas of the state. Widmann (1907) stated that the Bachman's sparrow was very common and breeding in Shannon County. Due to the presence of pine wood on FLW, and an active timber management program, if pine wood areas are selectively harvested, these areas should be surveyed for this sparrow.

Henslow's sparrow (Federal–formerly C2, MO–Rare) was initially included as a target species. However, further review of the literature indicated that the likelihood of finding this species on FLW was very low. Robbins and Easterla (1992) consider this a locally uncommon summer resident in the Osage Plains; scarcer and extremely local in the Ozark Border; and very rare and local in the Glaciated Plains. Henslow's sparrow is primarily found on prairies and in the western and northern parts of Missouri. A reproducing population of this species is unlikely to occur on FLW.

Although bald eagles (Federal–Threatened, MO–Endangered) were not observed nesting on FLW during this survey, bald eagles are regularly observed along the larger streams on FLW during the winter months and during migration (3D/Environmental 1996). Bald eagles are primarily seen along the major rivers, larger marshes, and at the larger reservoirs in Missouri. Robbins and Easterla (1992) consider the bald eagle an uncommon transient and winter resident and currently a very rare and local summer resident. Bald eagles have successfully nested along the Gasconade River and attempted nesting on the Big Piney River. Suitable habitat exists along the Big Piney River and Roubidoux Creek on FLW, and it is not unlikely that bald eagles may one day nest within the boundaries of FLW.

Although not previously reported from FLW, and not found during the survey, the loggerhead shrike (Federal–formerly C2, MO–Watch List) was considered a target species due to available suitable habitat (open areas with scattered trees, bushes, and hedgerows) on the installation. Loggerhead shrikes are an uncommon permanent resident in the western glaciated plains, Osage plains, and the Mississippi lowlands, and is rare elsewhere. This shrike is generally more common in the Ozarks today than at the turn of century due to clearing of the forests (Robbins and Easterla 1992). It is possible that this species occurs on FLW and will be found during future surveys.

Late evening surveys for black-crowned night-heron (MO–Rare) were conducted in the backwater slough areas adjacent to Big Piney River and the other large bodies of water on the installation. All surveys were unsuccessful. This night-heron nests in marshes, swamps, ponds, and lakes primarily in southeast Missouri (Robbins and Easterla 1992). It is an uncommon transient statewide, locally an uncommon summer resident in Mississippi lowlands, and rare elsewhere. It is doubtful that the black-crowned night-heron will have a reproducing population on FLW.

Prior reports exist for the barn owl (MO–Rare) on FLW (Roubidoux Creek bottoms in 1992); however, this species was not observed during the survey. The owl hunts and breeds in open country with scattered trees, often nesting in abandoned buildings, big hollow trees, or in hollows in cliffs. Robbins and Easterla (1992) consider the barn owl a rare permanent resident. Widmann (1907) states that "this owl was a rather rare resident...but not in the Ozarks and the southeast which are too densely wooded." Barn owls are now found in lowlands and the Ozarks, due to logging and removal of timber. However, it is primarily found in agricultural areas of the southwestern and southeastern section of the state (Robbins and Easterla 1992). FLW may be too wooded to attract this species.

Listed Bird Species Accounts

Pied-billed grebe (MO–Rare)

Survey results: It was not expected that this species would be found on FLW except during migration. However, it was observed twice during the fall migration in 1994; once on Bloodland Lake and the other on the new impoundment near Macedonia Cemetery.

Previous sightings on FLW: Regularly seen on Bloodland Lake during spring and fall migrations.

General habitat: Pied-billed grebes are found on most types of waters (lakes, ponds, rivers) during migration. This species primarily breeds in marshes with a relatively high water level north of the Missouri River (Robbins and Easterla 1992).

Missouri distribution: Common migrant; rare and local summer resident statewide; uncommon winter resident, primarily in the south. Nests north of the Missouri River (Robbins and Easterla 1992).

Natural Heritage Database information: Of 24 extant records, 7 are confirmed breeding occurrences. The closest record to FLW is in Texas County; reproduction was not confirmed for this record.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: Unlikely to have a reproducing population on FLW.

Great egret (MO–Rare)

Survey results: In 1994, observed during fall migration over Big Piney River.

Previous sightings on FLW: None.

General habitat: This species nests in every type of shallow water habitat, especially marshes (Robbins and Easterla 1992).

Missouri distribution: Uncommon transient and summer visitant; locally rare summer resident; accidental winter visitant. There are a few breeding colonies in Missouri, primarily in southeastern Missouri (Robbins and Easterla 1992).

Natural Heritage Database information: Six records of rookeries in Missouri within the last 3 years — four located near the Mississippi River and two near the Missouri River.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: Appears to be increasing gradually since the decline of the demand for plume feathers. Unlikely to have a reproducing population on FLW.

Cooper's hawk (MO–Rare)

Survey results: This species was spotted five times on FLW — twice in 1994 and three times in 1995. With the exception of one sighting in 1994, all were made within dates when an individual's occurrence likely indicates breeding (Missouri Breeding Bird Atlas, unpublished). Although it was not possible to verify breeding and successful nesting on FLW during this survey, evidence suggests the probability of nesting (i.e., sighting of male-female pairs and of three birds all of similar size [possibly recently fledged immature birds] late within the breeding safe dates).

Previous sightings on FLW: Several sightings in upland areas and an active nest in pine plantations near LCTA plots #60 and 43 (1992 and 1993).

General habitat: The preferred nesting habitat is mature forest, especially with shortleaf pine or mixed deciduous/coniferous forest with open areas interspersed (Reynolds and Meslow 1984). The large nest is usually close to a clearing near water.

Missouri distribution: Rare transient and winter resident, rare summer resident in Ozarks and Ozark Border, and extremely rare elsewhere. Uncommon winter resident in small numbers; most common in Ozarks (Robbins and Easterla 1992).

Natural Heritage Database information: Fifty-two extant nesting records, primarily from Kritz (1989). The closest nesting occurrence to FLW is on Forest Service land, less than 1 mile west of FLW from 1986.

Rangewide status: The Nature Conservancy ranked this as a G4 species, indicating that globally it is widespread, abundant, and apparently secure, but with cause for long-term concern.

Comments: Pine plantations and mixed pine/hardwood forests are available on FLW for nesting Cooper's hawks. Portions of Big Piney River and Roubidoux Creek are bounded by lowland woods. More numerous as a breeder than sharp-shinned hawks, and less common as a migrant than sharp-shinned hawks. Kritz (1989) indicated that the center of abundance is in the most heavily forested areas of the state, the east central Ozarks and the Ozark border. Of 43 nests, 67 percent were in *P. echinata*.

Sharp-shinned hawk (MO–Rare)

Survey results: This hawk was observed four times on FLW: three in 1994 and one in 1995. Only one of the sightings was within the safe breeding dates. All observations consisted of single hawks.

Previous sightings on FLW: Several sightings in upland areas and an active nest in a pine plantation near LCTA plots # 113 and 88 (1992 and 1993).

General habitat: Sharp-shinned hawks prefer dense coniferous forests, especially with *P. echinata* stands, for nesting (Robbins and Easterla 1992).

Missouri distribution: Uncommon transient and winter resident; rare summer resident, primarily in Ozarks (Robbins and Easterla 1992).

Natural Heritage Database information: Sixteen extant records, primarily from Kritz (1989). The closest nesting occurrence is southeast of FLW in Phelps County (from 1986).

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: Pine plantations and mixed pine/hardwood forests are available on FLW for nesting hawks. Portions of Big Piney River and Roubidoux Creek are bounded by lowland woods. A scarcer breeder than Cooper's hawk, Kritz (1989) located 17 nests during 1985-86 in the south central Ozarks and Ozark border, including Pulaski, Phelps, and Texas counties. All but one of the nests were in *P. echinata* stands.

Red-shouldered hawk (MO–Watch List)

Survey results: This hawk was observed five times on FLW: two in 1994 and three in 1995. All sightings were made within the breeding period, and two reported juveniles and/or fledgling birds. Additionally, this hawk was often heard calling along the Big Piney River while fish surveys were being conducted.

Previous sightings on FLW: Frequently observed in the bottomlands of the Big Piney River and Roubidoux Creek by MAPS personnel: Miller Pond Station (one bird, 1995), Macedonia Station (one bird, 1995), Big Piney Station (two birds, 1993; one bird, 1995), Miller Ridge Station (two birds, 1993; one bird, 1995), Laughlin Bottoms Station (three birds, 1993; two birds, 1995), and Smith Ridge Station (one bird, 1993; one bird, 1995). Active nest found near quarry on Big Piney River in 1992 and 1993.

General habitat: These birds prefer moist, lowland deciduous forests along streams and are almost exclusively found in these areas (Robbins and Easterla 1992).

Missouri distribution: Uncommon permanent resident in the Ozarks and Ozark border, rare in Osage plains, and north central and northeastern section of the glaciated plains. In winter, uncommon along Ozark streams and rivers (Robbins and Easterla 1992).

Natural Heritage Database information: Ten extant records. Most recent nesting record is from FLW surveys.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: Improved riparian forests have benefited this species.

Osprey (MO–Extirpated)

Survey results: In 1995, one osprey was observed during spring migration.

Previous sightings on FLW: Observed in Big Piney River and Roubidoux Creek corridors during migration.

General habitat: This species is usually associated with large lakes, reservoirs, and rivers.

Missouri distribution: Uncommon transient; casual summer visitant, former summer resident; casual winter resident. In the FLW region in the late 1800s, was found along the Gasconade and Osage rivers. However, by 1900 the bird was apparently extirpated or nearly so as a nester (Robbins and Easterla 1992).

Natural Heritage Database information: One historic nesting record.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: No known recent nesting attempts in Missouri. MDC initiated a hacking program in the state in 1995.

Brown creeper (MO–Status Undetermined)

Survey results: In 1994, one adult was observed feeding young in Ballard Hollow.

Previous sightings on FLW: In 1992 and 1993, this bird was seen in Big Piney River bottomland near Training Area 70 and near the quarry slough on the Big Piney.

General habitat: Breeds in coniferous or mixed forests and in wooded swampy areas where there are trees with loose or peeling bark (Harrison 1975). Nest is often located beneath a piece of loose bark.

Missouri distribution: Common transient; uncommon winter resident; casual summer resident in the Mississippi lowlands (Robbins and Easterla 1992).

Natural Heritage Database information: Two records, one from FLW.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: This sighting and those made by FLW staff during the breeding months are important observations, as this species is thought to restrict its breeding habitat to southern Missouri.

Bewick's wren (MO–Watch List)

Survey results: During the 1994 breeding season, one singing wren was observed, in the cantonment area of FLW. Indication of possible nesting on FLW.

Previous sightings on FLW: Several sightings made during LCTA surveys in brushy old field successional areas bordering woodland in 1990-1993. Several sightings made by MAPS personnel: Miller Pond Station (two birds, 1993; one bird, 1994; four birds, 1995), Macedonia Station (one bird, 1995), Big Piney Station (four birds, 1995), Laughlin Bottoms Station (one bird, 1993; six birds, 1995).

General habitat: In Missouri, this wren breeds in open, brushy areas near forest edge, and near buildings or equipment in agricultural areas and suburbs beginning in mid-March (Robbins and Easterla 1992).

Missouri distribution: Uncommon summer and rare winter resident in the Ozarks and Ozark border; rare and more local summer resident in Osage plains; casual summer resident and rare transient in glaciated plains (Robbins and Easterla 1992).

Natural Heritage Database information: One record from FLW.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: It is thought the decrease of Bewick's wren is related to the clearing of brushy habitats as well as clearing of areas around farmsteads. Cowbird parasitism may also play a role. This species is more common in rural areas of the Ozarks.

Marsh wren (MO–Status Undetermined)

Survey results: One wren was observed foraging near Penns Pond during the fall migration in 1994.

Previous sightings on FLW: None.

General habitat: Only known to breed in marshes (primarily cattail) north of the Missouri River (Robbins and Easterla 1992). Also seen in brush piles and wet fields during migration.

Missouri distribution: Uncommon transient; rare summer resident in north; casual winter resident (Robbins and Easterla 1992).

Natural Heritage Database information: Of two extant records, one is from FLW.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: Unlikely that reproducing populations will occur on FLW.

Bell's vireo (MO–Watch List)

Survey results: One observation of this vireo was made during the survey. This bird was seen and heard during the breeding season in breeding habitat, indicating possible nesting on FLW.

Previous sightings on FLW: Numerous sightings near LCTA plots #8, #47, #74, #100, #301, and #301 between 1990 and 1992.

General habitat: Mid-successional upland or lowland shrub habitat, with thickets and brushy hedgerows (Robbins and Easterla 1992).

Missouri distribution: Uncommon summer resident in Osage and western half of glaciated plains, rare elsewhere (Robbins and Easterla 1992).

Natural Heritage Database information: Two extant records.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: Breeding Bird Survey (BBS) data indicate this species has been on a steady decline since the early 1980s. The Breeding Bird Atlas shows high rates of cowbird parasitism. Future surveys may confirm nesting on FLW in small numbers.

Chestnut-sided warbler (MO–Status Undetermined)

Survey results: Surveys were not directed at this species as it is primarily found in the eastern part of the state. One observation was made during spring migration of 1995, above Big Piney River and near the post golf course.

Previous sightings on FLW: In 1992 and 1993, observed during migration in woodland and forested areas.

General habitat: During migration, woodland and forest; breeds in brushy second growth at forest edge. Early reports indicate it was repeatedly found breeding in

eastern Missouri in places with hazel, blackberry, and scrub-oak (Robbins and Easterla 1992).

Missouri distribution: Common transient; casual summer resident in east. Probably a more regular breeder in the eastern section of the Ozarks and Ozark border than the few records indicate (Robbins and Easterla 1992).

Natural Heritage Database information: None.

Rangewide status: The Nature Conservancy ranks this as a G5 species, indicating that globally it is demonstrably widespread, abundant, and secure.

Comments: Unlikely that reproducing populations will occur on FLW.

Cerulean warbler (Federal–formerly C2; MO–Watch List)

Survey results: Four confirmed sightings of this warbler were made during this survey — three in 1994 and one in 1995. Observations were all within accepted breeding safe dates and in suitable breeding habitat. In addition, 12 sightings were made in 1995 along the Big Piney River and Roubidoux Creek. These areas are both typical of cerulean warbler nesting habitat. However, the warblers were only identified by song. Although researchers initially were positive of the identification, northern parulas were later heard and seen, giving an unusual call that had been attributed to the cerulean warbler.

Previous sightings on FLW: Several sightings in riparian areas between 1990 and 1993. Several sightings made by MAPS personnel: Big Piney Station (23 birds, 1993; 4 birds, 1994; 4 birds, 1995), Miller Ridge Station (6 birds, 1993; 3 birds, 1994; 2 birds, 1995), Laughlin Bottoms Station (15 birds, 1993; 2 birds, 1994; 1 bird, 1995).

General habitat: Primarily in mature bottomland woodland and forest with nests placed high in a deciduous tree (Boyd 1986).

Missouri distribution: Uncommon summer resident in the Ozarks, Ozark border, and Mississippi lowlands; rare in the glaciated and Osage plains (Robbins and Easterla 1992).

Natural Heritage Database information: Four records, all from FLW.

Rangewide status: The Nature Conservancy ranked this as a G4 species, indicating that globally it is widespread, abundant, and apparently secure, but with cause for long-term concern.

Comments: BBS information indicates this species declined in abundance at an average annual rate of 4.24 percent between 1966 and 1994. However, due to the limited field effort in riparian areas by these surveys, this species may be under-counted. Suitable nesting habitat is available on FLW due to the extensive riparian corridors along portions of Big Piney River and Roubidoux Creek.

Objective 5 — Floral Inventory of Falls Hollow Sandstone Glades

Before this project, no known floristic survey had been undertaken at Falls Hollow. Forty-one field trips were taken to Falls Hollow between 1 April and 23 October 1994. Falls Hollow was visited at least once a week, sometimes twice a week, depending on the time of year; each glade was visited on all field trips to Falls Hollow. In addition, other high quality areas on FLW were visited every 2 weeks.

The flora of Falls Hollow is represented by 5 divisions, 63 families, 167 genera, and 215 species of vascular plants, 5 species of bryophytes, and 6 species of lichens. The results of the floristic inventory conducted at Falls Hollow can be found in Table 22. Locations of the four glades are shown in Figure 8. For a more complete discussion of the floristic inventory, see Hays (1996).

The plants located at Falls Hollow are those expected in a glade community of sandstone substrate. No known plant species are endemic to Roubidoux sandstone. Three listed species, *Silene regia*, Federal–formerly 3C, MO–Watch List; *Sporobolus ozarkanus*, Federal–formerly 3C, MO–Status Undetermined; and *Trifolium reflexum var. reflexum*, MO–Status Undetermined; were found at Falls Hollow. Accounts of these plants are presented under Objective 7.

One additional small sandstone glade was located east of the three glades identified at Falls Hollow by Ryan (1992). The largest of the sandstone glades at Falls Hollow is the most heavily disturbed of the four glades present (Hays 1996). The disturbance is primarily due to gravel wash and soil deposition associated with the maintenance of the road running east of Range 22. This glade does have a high native species composition, but a number of species associated with disturbance are also represented. The three smaller glades are of better quality, having had less disturbance. Almost all of the plants on these three glades are native and expected on the droughty conditions common to glades.

Thirty-eight new plant taxa were added to the known flora of Pulaski County (Table 23). A number of these species are common and probably have been overlooked by collectors. These new taxa are located throughout FLW. Voucher specimens were deposited at the Missouri Botanical Garden Herbarium, St. Louis.

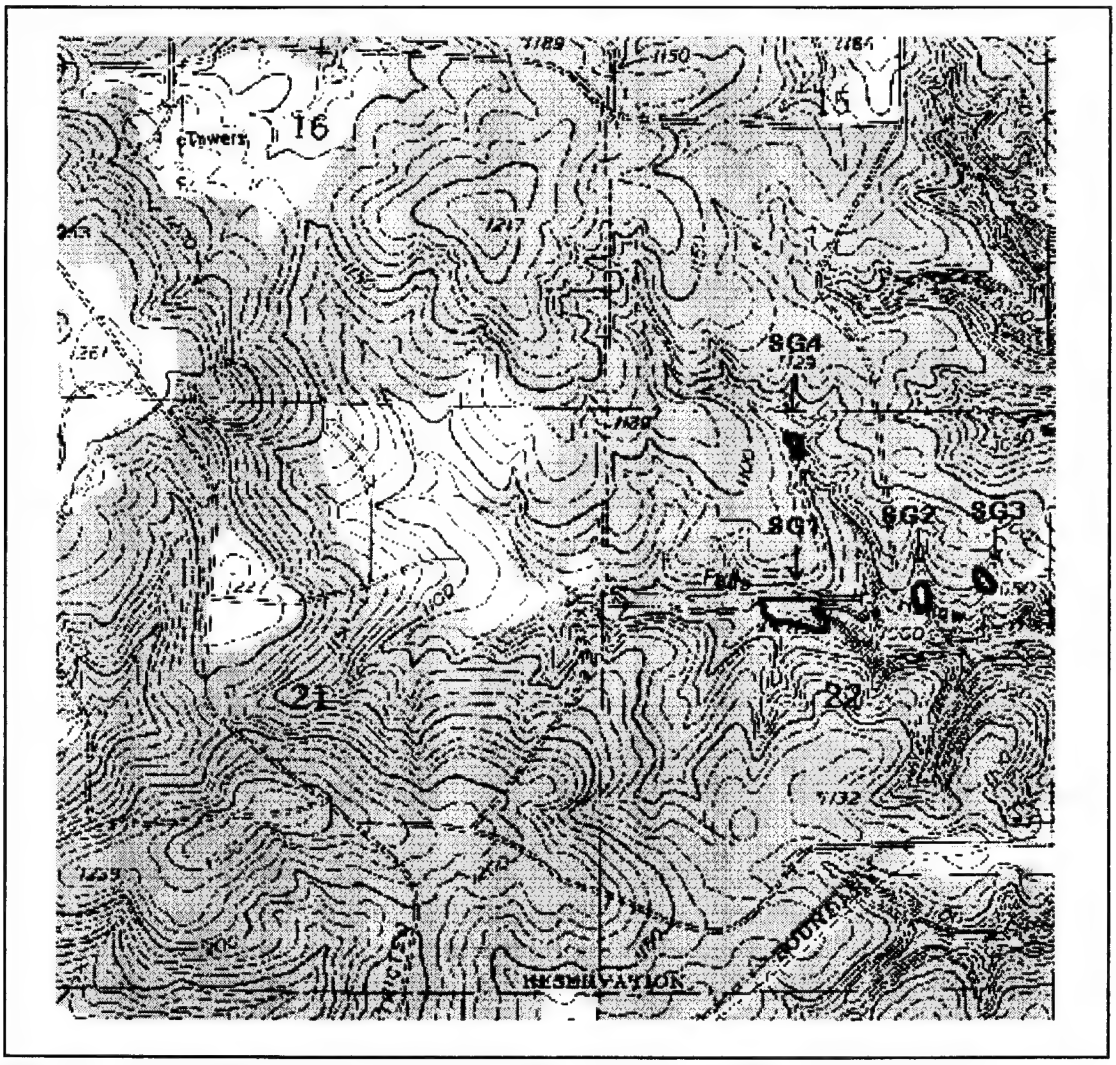


Figure 8. Location and designation of Falls Hollow sandstone glades (SG1-SG4), FLW — Bloodland, MO Quadrangle.

Objective 6 — Falls Hollow Sandstone Glade Natural Area Evaluation

Falls Hollow and Solomon Hollow on the Mark Twain National Forest were visited on 28 April 1995 by Karen Kramer (MDC, Natural Areas Coordinator), Lynda Richards (USFS), Steve Thurman (FLW Forester), and Hillary Loring (MDC Natural History Biologist). The purpose of this visit was to assess the quality of the two areas and their potential as Missouri Natural Areas. (A designated Natural Area represents the best example of a specific community within each Natural Division.) Both sites are classified as Significant Roubidoux sandstone glades and of Grade B quality. It was hoped that one of the sites would qualify for nomination as a state Natural Area as the best example of a sandstone glade on Roubidoux formation in the upper Ozark Section of the Ozark Natural Division.

Solomon Hollow

Solomon Hollow is a series of glades apparently caused by the intermittent surfacing of a particular rock stratum. It is surrounded by an exceptional quality forest, much of which consists of savanna remnants. Large open-grown trees are scattered within a younger-aged matrix. If a significant forest buffer could be secured, the potential for savanna restoration, combined with glade management, would make Solomon Hollow a very appealing Natural Area. Although the glades themselves are small, their combined area is probably larger than that of the Falls Hollow glade complex. The glade area is reasonably accessible and convenient to Rolla.

Falls Hollow

The largest sandstone glade at Falls Hollow is a more cohesive glade than those at Solomon Hollow. However, the glades themselves make up only an approximate four acres. Falls Hollow has long been recognized as an interesting geologic feature (Beveridge 1980). The exposed stratum of Roubidoux sandstone at the main glade appears thicker than that at Solomon Hollow and seems to erode differently. The largest glade at Falls Hollow has been heavily disturbed, and weedy native and exotic plants are common. Additionally, few plants considered conservative for glades occur on Falls Hollow. The three smaller glades are of higher quality, have fewer weedy plants, and are relatively undisturbed. Currently, Falls Hollow does not have a buffer zone around it. The glades are bordered by an active firing range and young low-quality woods. There may be potential for some savanna restoration in the canyon below the glades.

Additional factors precluding Falls Hollow sandstone glades from nomination to the Missouri Natural Areas Program include: (1) gravel, trash, and mud wash onto the glade from roads that border the area; thus depositing seeds of exotic species, and (2) public access to Falls Hollow is difficult because of its proximity to an active firing range.

Due to these factors and the existence of another glade on Roubidoux sandstone located in the more readily accessible and protected Mark Twain National Forest, Falls Hollow sandstone glades does not meet the required conditions to be a Missouri Natural Area. However, this is a unique area and should be managed and protected.

Objective 7 — Federally and State-Listed Plant and Exemplary Natural Community Surveys

Listed Plants

Four of a possible 54 plants of conservation concern were identified as possibly occurring on FLW (Table 24). Site locations are presented in Table 25 and Figure 9. A discussion of each listed species identified on FLW is presented under **Listed Plant Species Accounts**.

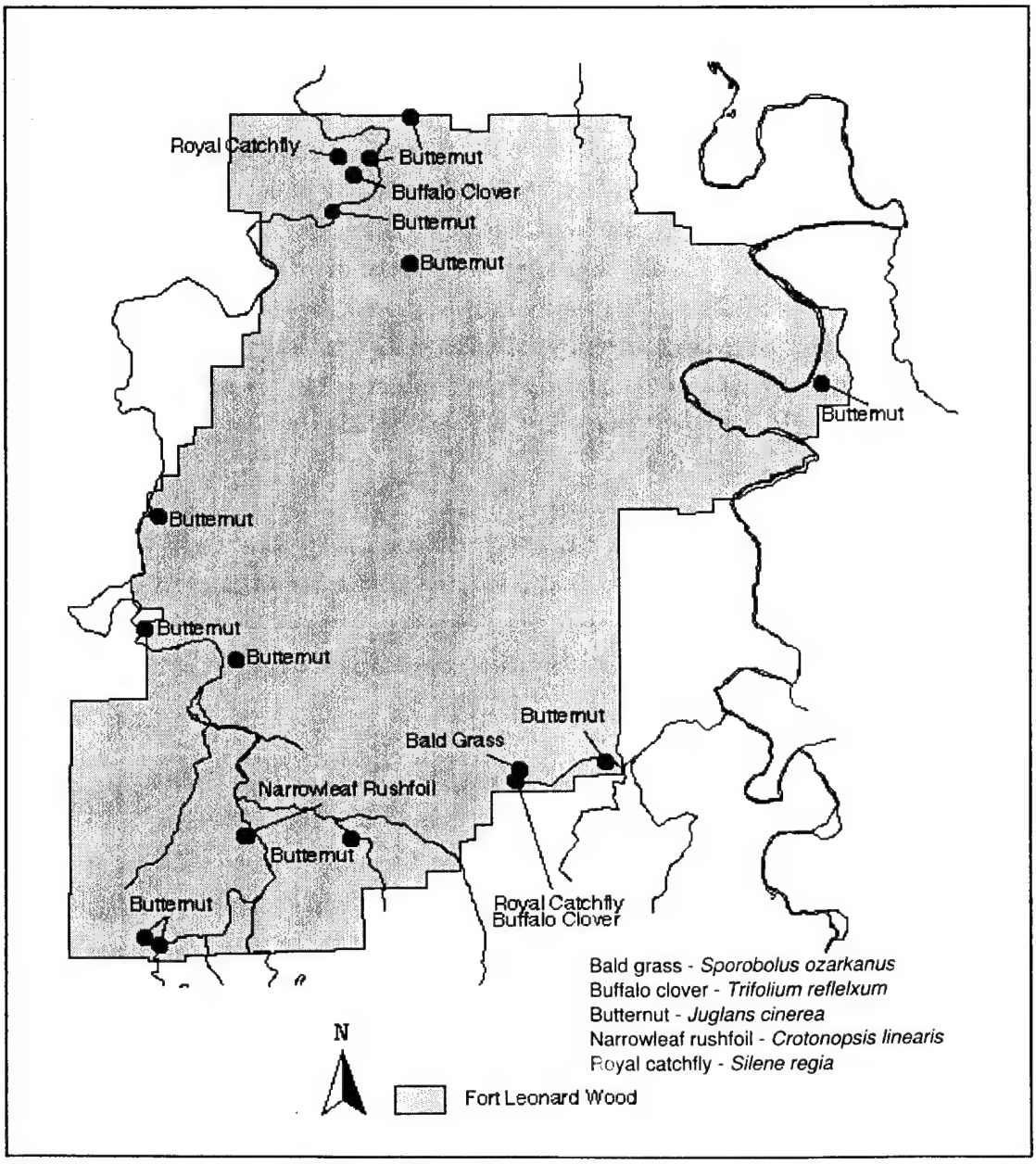


Figure 9. Location of Federally and state-listed plants on FLW.

Although 51 of the 54 listed plants were not located, failure to find them does not mean they are not present on FLW. Further survey work may find some of these species occurring on the installation.

Two additional listed species have previously been identified on FLW. *Crotonopsis linearis*, a Missouri-Status Undetermined species, was identified on the west side of Roubidoux Creek, south of Cookville, in 1932. This record was made by J. Steyermark and was included in the NHD due to a herbarium specimen on the Field Museum in Chicago (Steyermark #4852, 7 August 1932). Searches by B. Summers in 1991 and J. Hays in 1994 were unsuccessful at relocating this occurrence. This plant is most often found in dry, sandy soils. As noted by Skinner (1991), Steyermark does not map a Pulaski County record for *Crotonopsis linearis* in *Flora of Missouri* (1963).

The second listed species previously identified on FLW is *Nemastylis nuttallii*, a MO–Status Undetermined species. Bill Summers found this species on FLW in 1991 during the Natural Features Inventory of the area (Ryan 1992). He found four fruiting plants approximately 0.5 miles south of Macedonia Cemetery. However, he did not collect a voucher specimen, and a return search in 1994 by J. Hays was unsuccessful. *Nemastylis nuttallii* is often found on limestone glades, cherty open woods above limestone slopes along stream bluffs; also found in *Quercus stellata / Q. alba, Andropogon* covered bluffs in the southeast corner of Missouri (Steyermark 1963).

Listed Plant Species Accounts

Sporobolus ozarkanus (Federal–formerly 3C; MO–Status Undetermined)

Survey results: Found at three sites on Falls Hollow glades on Roubidoux sandstone. Approximately 25 plants were located on sites characterized as having poor soil with large fragments of sandstone.

Previous sightings on FLW: None.

General habitat: This species generally occurs on limestone or dolomite glades, cherty openings in woods, fields, along railroads, and waste ground (Steyermark 1963).

Missouri distribution: Mostly in the Ozark region.

Natural Heritage Database information: The NHD contains 30 records for *S. ozarkanus* in Missouri, all occurring within the Ozark Natural Division. Twenty-one

records are extant and nine are historic. Three high quality populations are known from nearby locations in Phelps County.

Rangewide status: The Nature Conservancy ranks this as a G5 species with questionable taxonomy. Globally this species is demonstrably widespread, abundant, and secure. It is now recognized as a species, rather than a hybrid, and recently described characteristic needed for proper identification are being used to locate additional populations.

Comments: This study produced the first report of this species from FLW and from Pulaski County.

Trifolium reflexum var. ***reflexum*** (MO–Status Undetermined)

Survey results: Found at Falls Hollow glades on Roubidoux sandstone and near Cedar Hill Cemetery glades above Roubidoux Creek along a ridge-top road on dolomite.

Previous sightings on FLW: None.

General habitat: This species occurs in rocky open woods, glades, fallow fields, and prairies, usually in acid soils (Steyermark 1963).

Missouri distribution: Located in the Ozark section of southern and central Missouri.

Natural Heritage Database information: The NHD contains 126 records for *T. reflexum var. reflexum* in Missouri — 73 extant and 53 historic records. Three extant records are near FLW.

Rangewide status: The Nature Conservancy ranks this as a G5 species with taxonomic questions. Globally this species is demonstrably widespread, abundant, and secure.

Comments: This species is new to FLW. Additional populations probably exist.

Juglans cinerea (Federal–formerly C2; MO–Watch List)

Survey results: Found in several drainages on FLW. All stands showed signs of disease. Survey results are described under Objective 8.

Previous sightings on FLW: Known from several drainages.

General habitat: *J. cinerea* occurs in rich woods along the base of slopes or bluffs, and along streams (Steyermark 1963).

Missouri distribution: Statewide.

Natural Heritage Database information: The NHD contains 91 records, 89 of which are extant, for *J. cinerea* in Missouri. These occurrences are primarily located in the southern half of the state.

Rangewide status: This species was proposed for Federal listing and is on the Missouri Watch List due to the recent devastation to the species, throughout its range in North America, by a fungus, *Sirococcus clavigignenti-juglandacearum*. The Nature Conservancy ranks this species as a G4 species, indicating that globally it is widespread, abundant, and apparently secure, but with cause for long-term concern.

Comments: Due to the widespread prevalence of the fungus, the future looks bleak for *J. cinerea*.

Silene regia (Federal–formerly 3C; MO–Watch List)

Survey results: Two new sites were found for this species on FLW. One site was near Falls Hollow glade on Roubidoux sandstone, and the other on a small, north facing dolomite opening above Roubidoux Creek. *S. regia* was in flower at both sites.

Previous sightings on FLW: One site in 1989 on bluffs above Roubidoux Creek. However, due to inaccuracies in voucher specimen labeling [see Skinner (1991) for discussion], this record was not included in the NHD. Return visits to the suspected location by J. Hays in 1994 were unsuccessful at locating this species.

General habitat: Rocky prairies, rocky open woods, thickets, and borders of rocky glades (Steyermark 1963).

Missouri distribution: Ozark Plateau and Springfield Plateau.

Natural Heritage Database information: The NHD contains 221 records for *S. regia* in Missouri, and with only a few exceptions, most are located in the Ozark Natural Division. Ninety-three records are extant, 25 are historic, and 3 have been destroyed.

Rangewide status: The Nature Conservancy ranks this as a G3 species, indicating that globally it is rare or uncommon.

Comments: This species appears to be secure in Missouri.

Additional Surveys of Listed Plants

Several other botanical surveys or field work requiring plant identification have been conducted on FLW. One study was specifically directed at rare plants (Skinner 1991), and two included plant identification as part of their project (Harland Bartholomew and Associates, Inc. 1995b; Johnson et al. 1990).

Skinner (1991) found three listed species during his survey: *Juglans cinerea*, *Nemastylis nuttallii*, and *Silene regia*. Skinner (1991) attempted to verify the seven state-listed plants identified by Johnson et al. (1990). He was unable to verify any of these plants due to lack of voucher specimens, misidentification by the 1990 study, incorrect taxonomy, or presence due to ornamental plantings.

The Wetland Inventory of FLW (Harland Bartholomew and Associates, Inc. 1995b) identified four species of plants included in the *Checklist of Rare and Endangered Species of Missouri* (MDC 1995). Unfortunately, vouchers were not taken of these plants during the wetland inventory. An attempt to verify these records was made on a visit to the locations for three of the species on 11 July 1995.

Carex aquatilis var. *aquatilis* — MO–Endangered. Failed to relocate species. However, numerous other Carex spp. were observed on the site, suggesting plants were misidentified in the field.

Juncus balticus var. *littoralis* — MO–Endangered. Failed to relocate species. It was listed as a dominant species on three sites. However, numerous other Juncus spp. were observed on the sites, suggesting plants were misidentified in the field.

Scirpus americanus — MO–Extirpated. Identified from one site. Populations of plants were found that keyed out to *S. americanus* (Steyermark 1963). However, according to Yatskievych and Turner (1990) the plant Steyermark identified as *S. americanus* is now classified as *S. pungens*, which is a common plant in Missouri. The listed *S. americanus* was formerly known as *S. olneyi*. The plant cited in the wetlands inventory was probably the more common species, identified using the older nomenclature.

Viburnum lentago (Nannyberry) — MO–Endangered. It was not possible to return to where this species was collected, as site information was unavailable.

Exemplary Natural Communities Survey

As a result of varying degrees of disturbance from past land-use practices, few high quality natural communities occur on FLW (Figure 10). Since its establishment in 1941, some portions of FLW have not been used for training activities or developed, and although not high quality, plant communities are recovering from previous land use. However, the mission of FLW is to train soldiers and engineers for battle. Training exercises often require use of tracked vehicles and demolitions, and neither practice is conducive to the existence of exemplary natural communities.

Exemplary natural communities not already noted by Ryan (1992) or Skinner (1991) were not found. Numerous small dolomite glades are located along Roubidoux Creek, Big Piney River, and several of their tributaries (Hays 1995; Skinner 1991). However, the majority of these glades are extremely small and are encroached upon by woody vegetation. Plant composition on these glades is similar, and based on the plants present, these glades are of C/B quality.

Ryan (1992) and Skinner (1991) found only four high quality natural communities on FLW. These four natural communities were ranked either as Significant or Notable:

1. *Falls Hollow sandstone glades.* T34N R11W S22 N2. Significant. Ca. four acres in three glades. Grade B. (A community is given a Grade B natural quality if it has the following characteristics: late successional or lightly disturbed; recently but lightly disturbed, or moderately disturbed in the past but now recovered; diversity has not been greatly reduced. For a glade, this means that it has light to moderate weedy or woody invasion.) This community was described under Objective 5 in this chapter.

2. *Pond marsh.* T35N R11W S20, Notable. Ca. four acres. Grade C+. (A community is given a Grade C if it has the following characteristics: mid-successional, moderate to heavily disturbed communities; moderate recent disturbance or heavy past disturbance; original structure changed and diversity lowered. For a pond marsh, this may mean that the area has been repeatedly drained. The "+" indicates the pond marsh tends to Grade B.) This community exhibited moderate diversity; disturbance form nearby roads increases occurrence of non-native weedy vegetation. Common species include *Cephalanthus occidentalis*, *Hybiscus spp.*, and *Scirpus spp.* The pond is damp in dry years. This community does not meet the current standards to be included in the NHD.

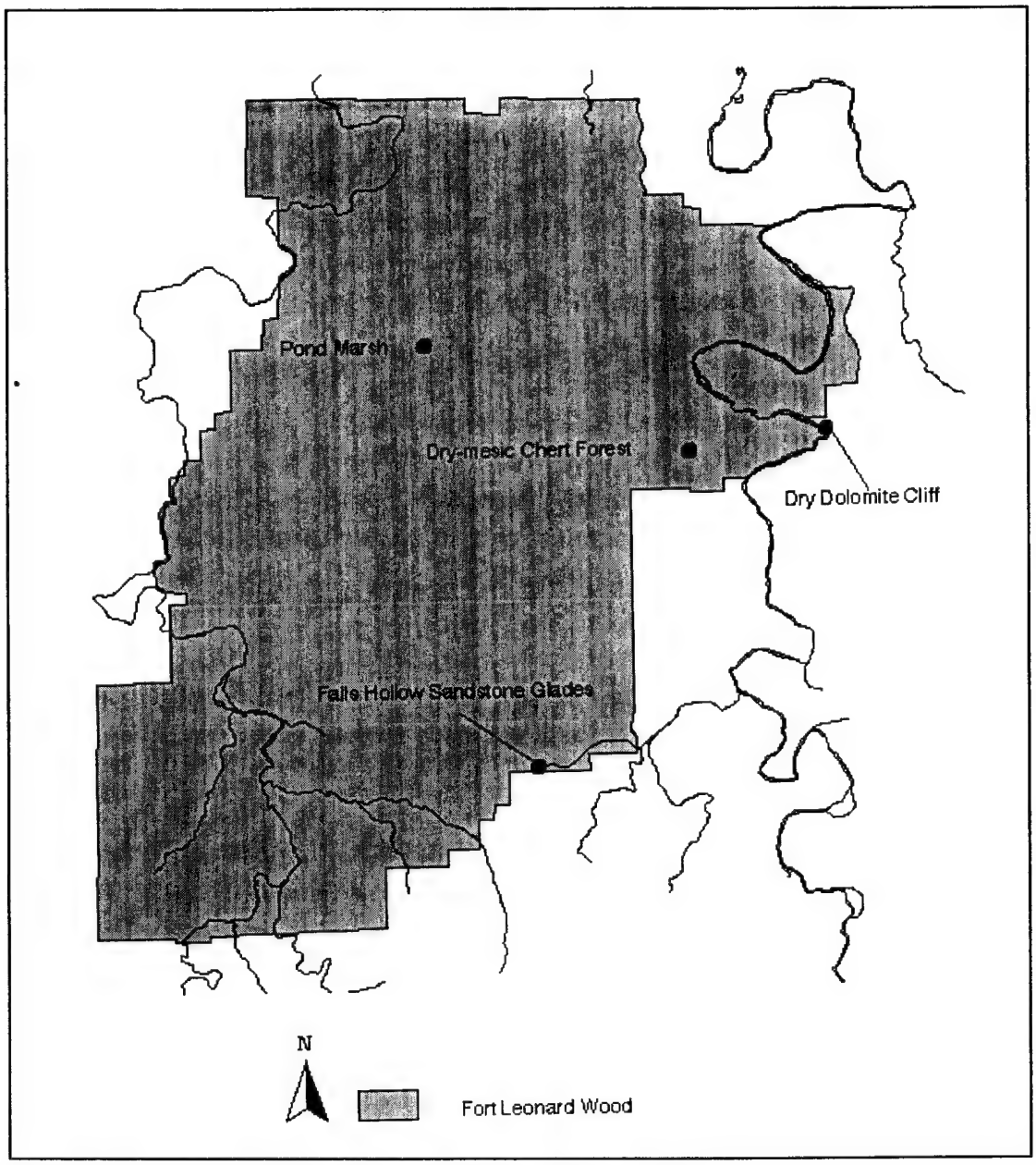


Figure 10. Location of high quality natural communities on FLW.

3. *Dry-mesic chert forest*. T35N R11W S36 E2 and T35N R10W S31 W2. Notable. Ca. 300 acres. Grade C. Mature to old-second growth. Not quite 90 years old. No recent disturbances. Small acreage of bottomland creek and dolomite cliff with glade edges add to diversity. Tree cores of several *Quercus* species (*Q. alba, Q. rubra, Q. velutina*) are all 65+ years old. Dominant canopy species include *Juglans nigra, Quercus stellata, Q. velutina, Q. alba, Carya tomentosa, C. texana,* and *Ulmus rubra*. Understory and ground flora includes: *Prunus serotina, Corylus americana, Cornus* spp., *Lindera benzoin, Staphylea trifolia, Acer saccharum, Chasmanthium latifolium, Eupatorium spp.*, and *Polystichum*

acrostichoides. This community does not meet the current standards to be included in the NHD.

4. *Dry limestone/dolomite cliff.* T35N R10W S32 NE4NE4 and S33 W2NW4. Along Big Piney River. Notable. Approximately 0.75 mi long, 250 ft high. Grade B-. Cliff with gladey blufftop and ledges, small wooded cove, and talus slopes. Good diversity of habitats on a tall bluff. Common species include *Pinus echinata*, *Quercus stellata*, *Q. prinoides*, *Cornus florida*, *Cercis canadensis*, *Schizachyrium scoparium*, *Aster spp.*, *Petalostemon spp.*, *Liatris cylindracea*, *Solidago nemoralis*, and *Rudbeckia missouriensis*.

Ryan (1992) identified Big Piney River as an Exceptional Small River aquatic community. However, two dams occur within the boundaries of FLW. The northern most dam (at East Gate Bridge) has been circumvented by a high-water flow channel west of the dam. The dam near the pumphouse blocks movement of fish upstream during much of the year, thereby impacting aquatic species composition upstream of the pumphouse.

Principle Natural Community Types

Although the primary focus of this inventory was to locate Federally and state-listed species on FLW, some understanding of the natural communities within which rare species populations occur is useful in understanding habitat and management needs of the species in question. Knowledge of natural communities present also assists biologists in their search for rare and endangered species, allowing them to predict or anticipate which species they can expect to find in a given area. However, a comprehensive survey of natural communities present on FLW was beyond the scope of this project. Determining all natural communities present would require a substantial investment of effort, including the collection of quantitative data.

FLW has several main natural communities types. Proffitt (1994) estimated that, today, 71.8 percent of FLW is covered with deciduous forest, with pine plantations accounting for an additional 6.2 percent of the land cover. Other habitats represented on FLW include prairie openings, limestone glades, sandstone glades, riparian forests, and abandoned farm fields in the process of reverting to forest cover.

The USFS developed an Ecological Land Classification for its forests (USFS 1981a, 1981b). This system is based on three elements: soils, landtype, and vegetation, which are used to predict potential natural vegetation and natural community types. FLW is within the Rolla-Houston Forest District, and Landtype Associations (LTA), and Ecological Landtypes (ELT) within each association are available for the region.

Information used to describe this classification system and the probable natural communities present on FLW is taken from the USFS description of its classification system (USFS 1981a, 1981b). The USFS primarily used natural communities as described by Nelson (1987) in its Ecological Land Classification system.

FLW is located within two LTAs: Oak-Hickory Hills (Limestone) and Oak-Hickory Plains (Limestone), with the former occurring primarily along the edges of FLW, and the latter in the interior on the plateau between Roubidoux Creek and Big Piney River. The parent material, limestone, is described as consisting of cherty dolomitic limestone with sandstone layers contributing no more than 35 percent of the total. The USFS chose to call the parent material limestone, rather than the more appropriate dolomite, because limestone is a more familiar term. However, as FLW is located on geologic formations that consist of dolomite, the term "dolomite" will be substituted here for the USFS's "limestone."

Both FLW LTAs have the same 18 ELTs. A brief description of each ELT along with its associated natural community is presented in Table 26. Each ELT is uniquely numbered and is the same across all Landtype Associations. State conservation ranks (S ranks) are used by the Missouri NHD to assign a conservation status to a given community type or species, with S1 indicating the most rare and imperiled to S5 indicating abundance and lack of threats.

At this hierarchical level, the land classification system does not include terrestrial wetlands or cave communities. This exclusion may be due to the small size of wetlands occurring within the Ozarks Natural Division. An ELT is typically between 1/10 to 1 sq mi; very few wetlands in the Ozarks are this large.

The USFS (1981b), based on topographic map sampling, determined the percentage of each ELT in a given LTA for lands in all ownership occurring within the Rolla-Houston Forest District. The ELTs with the greatest percentage of occurrence in the Oak-Hickory Hills (Limestone) and Oak-Hickory Plains (Limestone) associations are presented in Table 27.

From this information, it is conjectured that the most prevalent non-wetland natural community types on FLW are chert savanna, dry chert forest, and dry-mesic chert forest, which are located throughout FLW, and dry bottomland forest and mesic bottomland forests located along the riparian corridors. Based on cursory site evaluations, these communities are prevalent throughout the FLW landscape.

The Natural Feature Inventory of the FLW region identified dry-mesic chert forests, dry-mesic and bottomland forests, and dolomite and sandstone glades on FLW (Ryan 1992). Most were considered poor quality due to logging, grazing, or invasion of

woody and non-native plants. Additionally, the wetland inventory (Harland Bartholomew and Associates, Inc. 1995b) identified numerous flood plain forests occurring along the riparian corridors on FLW.

Eight wetland types, based upon hydrology, hydric soils, and hydrophytic vegetation, were identified on FLW during the wetland inventory of 1993-1994. Wetland types and the corresponding natural community as described by Nelson (1987) are presented in Table 28.

Bottomland hardwood forests are the most abundant wetlands on FLW. These wetlands are associated with flood plains. The best examples occur along Big Piney River and Roubidoux Creek.

Shallow fresh marshes are located throughout FLW and are not specific to a given region of the installation. These wetlands are small and often associated with the shallow margin of manmade ponds, with seepage zones below dams, and with standing water in old tire ruts and old bomb craters. Although Harland Bartholomew and Associates (1995b) compared these to Nelson's (1987) freshwater marsh, fens, and deep muck fens, further analysis of the plant community, and size and location of each wetland is not typical of those described by Nelson (1987). Freshwater marshes, fens, and especially deep muck fens are relatively rare throughout Missouri and are not generally considered common in the Ozarks.

Shrub swamps occurred mostly along sluggish streams, in wet depressions, and on stream flood plain in the headwaters of larger ponds on the installation.

Shrub flats occurred along the broader flood plain of Big Piney River and Roubidoux Creek and along the edges of several manmade ponds and reservoirs.

Wet meadows occurred in shallow depressions on flat terrain, and most were very small.

Gravel bars are located in drainages throughout FLW. However, only those supporting vegetation are considered wetland; thus, the actual number and acreage is probably under-reported.

Deep fresh marshes occurred primarily along the deeper marshes of manmade ponds, and in old bomb craters.

Springs were divided into two phases: (1) aquatic — permanently flooded and (2) terrestrial — associated with groundwater seep or discharge areas. Aquatic phase springs (e.g., Stone Mill Spring) are rare on FLW. Terrestrial phase springs

(Turnbull Hollow spring, Musgrave Hollow spring) are common throughout the installation and were often overlooked likely due to their small size.

Caves

Cave natural communities are common on FLW. Forty-five caves are known to occur on the installation (Oesch and Oesch 1986). Nelson (1987) described five cave natural communities: effluent, influent, dry pit, wet pit, and dry.

Community Rarity

Based on predicted terrestrial communities (LTA-ELT) and actual wetland communities identified on FLW and their respective suggested state conservation statuses, the following communities on FLW have state significance and should be protected from disturbance: wet-mesic bottomland forest (S2), chert savanna (S1), and all wetlands with the exception of pond marsh communities, which are well represented on the Missouri landscape. These natural communities are threatened throughout Missouri, due to anthropogenic land uses and, if possible, should be protected and enhanced through sound land management practices and proactive land-use planning.

Objective 8 — *Juglans cinerea* Survey

Juglans cinerea trees are being killed throughout their 26 state range by *Sirococcus clavigignenti-juglandacearum*, a fungus that causes branch and stem cankers, which eventually girdle the tree causing death. *J. cinerea* occurs on FLW and diseased trees are present. The main purpose of this survey was to determine the extent of infection within populations of *J. cinerea* on FLW. Although this was not designed as an all-inclusive survey of the *J. cinerea* of FLW, a better estimate of the occurrence of this species on FLW was a secondary objective.

While *J. cinerea* is the only known natural host for the fungus, *J. nigra* and other *Juglans* species have been infected through artificial inoculation procedures (Sinclair, Lyon, and Johnson 1987). The potential spread of the fungus to these species carries heavy economic importance. *J. cinerea* was formerly considered a valuable tree for its wood, nuts, and landscape potential throughout the northeastern United States (Ostry, Mielke, and Skilling 1994).

The presence of the fungus is visually indicated by dark brown elliptical lesions, areas of bark uplifted by hyphal pegs, and brownish-black stains where degraded inner bark has oozed to the surface. Adventitious sprouts commonly grow from the

edges of cankers on trunks or limbs and at the base of severely infected trees. These sprouts are usually short-lived due to rapid infection by the fungus. The disease is known to be spread by conidia which are extruded during wet weather and dispersed by splashing rain. A long-distance dispersal method is still unknown (Sinclair, Lyon, and Johnson 1987).

J. cinerea grows best on well-drained, gravelly soil on stream benches and terraces. It also occurs on dry, rocky soils, especially those of limestone origin. *J. cinerea* is seldom found on dry, compact, or infertile soils (Fowells 1965).

J. cinerea trees were found at 10 of the 19 areas examined (Table 25; Figure 9). Data were collected on 102 live *J. cinerea* trees (Table 29). All but two of the trees exhibited cankers or other indications of fungal disease. All of the *J. cinerea* had some amount of canopy dieback. Since the survey was conducted in winter, active oozing of cankers was not seen.

Trees occurred on five soil types: Cedargap cherty silt loam, Clarksville-Gepp very cherty silt loam, Gepp-Rock outcrop complex, Gepp-Bardley-Clarksville very cherty silt loam, and Nolin silt loam (Wolf 1989). *J. cinerea* were found in areas underlain by both the Gasconade and Roubidoux formations (Missouri Geological Survey 1961). The one area examined that was underlain by the Jefferson City-Cotter Formation yielded no *J. cinerea* This bedrock occurs above the Roubidoux Formation and occupies the broad upland areas. *J. cinerea* on FLW more commonly occurs in a lower, more dissected landscape.

Young trees were scarce. Two young and apparently healthy trees were noted at the Cedar Hill Cemetery site. Young trees were also recorded at the Tunnel Hollow site along with the largest *J. cinerea* noted in the survey. The health of this large tree was difficult to determine.

Recommendations

The future looks bleak for *J. cinerea*. There is no way to stop the spread of the fungus attacking the tree, and most trees appear to be infected and will probably die eventually. Actively growing trees with old cankers may indicate disease resistance and should be inspected every few years. Three areas that might warrant re-examination are Cedar Hill Cemetery, Musgrave Hollow, and Tunnel Hollow. Each of these sites contained comparatively large and multi-aged populations.

Objective 9 — Federally Endangered Species and Other Listed Species Not Included in Field Surveys

Gray Bat

Gray bats primarily use FLW during the summer breeding period (April-October). Only a few individuals have been noted hibernating in any of the caves on the installation. One maternity and several transient gray bat caves occur on FLW. These caves are located along Roubidoux Creek, on the west side of the installation. Significant maternity caves are surveyed biennially by Rick Clawson (MDC Wildlife Research Biologist). Wildlife biologists with FLW's Natural Resources Branch survey caves on FLW with R. Clawson's assistance. Transient caves are inspected on a less frequent basis and were inventoried in 1994 by MDC-Natural History Division staff.

The gray bat appears to be increasing throughout its range, and may eventually have its Federal conservation status upgraded to Threatened. Although numbers of bats observed on FLW do show fluctuations over the years, the population appears stable presently. FLW has established Endangered bat management zones around significant bat caves.

Indiana Bat

One hibernaculum occurs on FLW. This cave is near the center of the installation. All significant Indiana bat hibernacula in Missouri are surveyed biennially. Since the 1970s, this cave has shown a drop in Indiana bats from approximately 19,500 to 750 bats in 1995. This number represents a 96 percent drop in the population. However, Indiana bats throughout Missouri have shown a marked decrease in population size, from approximately 227,225 to 29,920 bats. This number is an 87 percent decrease in the population.

Three additional caves on FLW are known to harbor hibernating Indiana bats. None of these caves are considered major hibernacula, and Indiana bat populations ranged from 29 to 135 bats. As with gray bat caves, all Indiana bat caves are included in the NHD of Missouri.

Numerous reasons for the population decline have been proposed. Two reasons most often suggested are pesticides (through direct and indirect pathways) and lack of summer breeding habitat. Overall, Indiana bats are declining range wide. However, several states within the range of Indiana bats have seen their state populations increase over the last few years. Research is ongoing to determine the reason(s) for this species' decline.

Prior to the 3/D Environmental (1996) study, Indiana bats were not known to occur on FLW during the summer months. Biologists thought females of this species used wooded riparian and upland areas north of the Missouri River for summer breeding habitat. Indiana bats roost under exfoliating bark or in snags. However, three Indiana bats, one pregnant, one lactating, and one male, were captured in mist nets on FLW during the summer months of 1994. This indicates Indiana bats are reproducing and foraging on FLW during the summer months, and are a concern year round.

Bat Cave Protection on FLW

All caves known to harbor gray bats or Indiana bats are protected on FLW. Restrictions were established to minimize disturbance either directly to the bats or to the surrounding foraging area. See Proffitt (1994) and the Integrated Natural Resources Management Plan 1993-1997 (Ecological Services Center n.d.) for a description of these management guidelines.

Caves are protected by: (1) restricting cave access during bat reproductive or hibernating periods, (2) maintaining contiguous forest in the 20 acres immediately surrounding cave entrances, (3) maintaining wooded travel corridors to foraging areas (primarily riparian zones for gray bats; riparian and upland forests for Indiana bats) and summer Indiana bat roosting habitat, and (4) varying levels of restrictions to disruptive activities during critical times.

Bald Eagle

Although not found in the large numbers associated with reservoirs and major rivers, wintering bald eagles do occur on FLW along portions of Roubidoux Creek (primarily in the southwest portion of the installation) and Big Piney River. These areas are used for roosting and foraging by the wintering raptors (3D/Environmental 1996). Wintering bald eagles are also known to occur along portions of these two streams off of FLW and on the Gasconade River. To date, no pair of bald eagles is known to have attempted nesting within the boundaries of FLW. However, as the number of bald eagle pairs nesting in Missouri continues to increase, it may only be a matter of time before they attempt to nest on FLW. Suitable habitat and nest trees exist along Roubidoux Creek and the Big Piney River flood plain on FLW.

American Burying Beetle

This species is listed as Endangered both Federally and by Missouri. Although this carrion beetle was last reported from Missouri in the 1980s (USFWS 1991), recent discoveries in Oklahoma and Arkansas (LeDoux, research associate, Univ. of

Missouri-Columbia, pers. comm.) indicate this species may still exist in Missouri. Historical records indicate this species tends to prefer open or riparian deciduous or scrub forests with grasses and sedges dominating the understory. This type of habitat exists at FLW.

Field surveys of suitable habitat should be conducted to determine the occurrence of this species on FLW. Surveys are best conducted during the summer months and involve pit-fall traps and with rotting meat as bait (LeDoux pers. comm.).

Other Federally and State-Listed Species

Several state-listed mammals occur on FLW. Proffitt (1994) collected specimens of eastern wood rat, golden mouse, and long-tailed weasel. Eastern small-footed myotis were captured in 1994 during mist net surveys by 3/D Environmental (1996).

Objective 10 — Biological Diversity and Ecosystem Management Recommendations

FLW is an active military installation and current land-use practices do not appear to impinge on its expected biological diversity. Several studies, in addition to this one, have added to the plants and animal species known to occur on FLW (Johnson et al. 1990; Proffitt 1994; DeSante, Walker, and Burton 1994; 3/D Environmental 1996; MAPS unpub. data). With a few exceptions, and given available suitable habitat, species of mussels, crayfish, fish, amphibians, reptiles, birds, mammals, and plants occurring on FLW represent what is expected to occur in this region of the Ozarks.

Although species lists from FLW suggest that biological diversity is relatively intact and generally consistent with the Upper Ozarks, species richness is a narrow assessment of biological diversity. Presence alone is not an indication that plant and animal populations are healthy and viable. Without information on population structure, it is only possible to make inferences regarding the biological integrity of the area. For example, habitat fragmentation can create "population sinks" for some species or groups of species. Whether the existing habitats at FLW are sufficiently managed to maintain the present level of biological diversity is not known for much of the flora and fauna.

Freshwater mussel communities of portions of Big Piney River and Roubidoux Creek sampled during this study have the expected level of species richness. All mussel species expected to occur in these streams (Oesch 1984; Buchanan pers. comm.) were located and several new species were discovered for both streams. Mussel beds on

Big Piney River were relatively diverse, usually 9 to 11 species; however, numbers were not always very high. Also, more live mussels were found on areas sampled outside of the boundaries of FLW than within the installation's boundaries. Additionally, very few young mussels were found anywhere on Big Piney River. These observations may represent sampling bias or lower species abundance and reproduction on FLW. The two dams on the Big Piney River on FLW may have affected stream conditions (i.e., water flow and depth, temperature, turbidity, substrate stability, fish host movements), thereby leading to poorer habitat conditions and fewer mussels. Roubidoux Creek had fewer species and numbers; however, this variance was expected due to the losing nature of much of the creek. Often all that remains in dry years are several large pools.

Four species of crayfish are known from the FLW area. Two stream species, spothanded and golden crayfish, occur in Big Piney River and Roubidoux Creek. Both species were collected in high numbers from all streams sampled. Additionally, the capture of many young crayfish of these two species and the observation of specimens in all age classes is evidence of healthy levels of reproduction. Although not located during the survey, the Salem cave crayfish occurs in nearby Roubidoux Spring. As portions of FLW are within the recharge area of this spring, this crayfish may occur on FLW. Chimneys of devil crayfish were not noted on FLW. However, as this species is relatively common, and suitable habitat is available on the installation, it likely occurs on FLW.

Fish species collected in portions of Big Piney River and Roubidoux Creek on FLW are comparable to those collected in the same streams by other biologists (Fleener et al. 1974a; Pflieger 1974 and 1975). Although large game fish (e.g., suckers, catfish) were not as well represented in the collections as in previous studies, this is primarily due to sampling bias. If more time had been spent using electroshocking equipment, more large game fish undoubtedly would have been collected. Additionally, species composition based on collections from headwater streams on the installation (i.e., Turnbull, Musgrave, McGann, Falls, Ballard, and Hurd hollows and East Gate Tributary) are consistent with those of similar order streams in the Ozark Faunal Region (Pflieger 1989). Young-of-the-year of many fish species were captured in all streams sampled. Overall, fish communities in the streams sampled on FLW appeared relatively intact.

Based on species richness, FLW appears to provide suitable habitat for those species of amphibians and reptiles expected to occur in the Upper Ozarks (Johnson 1992). With the exception of several large snakes and hard to catch aquatic turtles, representatives were found of all species commonly occurring in the Upper Ozarks Division. Several listed species (eastern hellbender, eastern collared lizard, four-toed salamander) were not located on FLW, primarily due to lack of suitable habitat.

However, these species have a patchy rangewide distribution and specialized habitat requirements. Larval forms and eggs of many amphibians and reptiles were observed on FLW, indicating that these species are reproducing and their populations are relatively healthy.

The bird community on FLW also appears intact. Over 190 species are known to use FLW during the year, either for nesting or migration, and many are year-round residents. These species are consistent with what is expected to occur in the Ozarks. Bird census information for breeding birds from the surrounding Mark Twain National Forest (USFS unpub. data.) indicates that species composition of the two areas is similar (although FLW appears to have more individuals of edge species than Mark Twain National Forest), implying that current land-use practices on FLW are not detrimental to birds. Additionally, available habitat offers a mosaic of different forest community structures.

Although this project did not include a survey of mammals on FLW, based upon personal observations and information from LCTA mammal trapping (Proffitt 1994), species expected to occur in this portion of the state are present on the installation (with the exception of several large predators or herbivores). Although historically occurring in the Ozarks, black bears, gray wolves, mountain lion, elk, and bison no longer occur on FLW. Black bears recently moved into Missouri from Arkansas, and may eventually occur on the installation.

Plant lists compiled by Johnson et al. (1990), Proffitt (1994), and Hays (1995) are indicative of the Ozarkian flora. However, numerous exotics occur throughout the installation, reflecting its agricultural past and current land-use practices. Exotics were planted for forage pasture and as ornamentals. They have also spread by accidental introduction from seeds carried by vehicles. Land disturbance also leads to changes in plant communities. Species intolerant of substrate disturbance are often replaced by tolerant species. Often, these tolerant species are not associated with the original plant community.

Biological diversity on a species level (based on species presence) appears relatively intact on FLW. However, on a landscape scale, natural community diversity has undoubtedly declined. Past land-use patterns, such as timber harvests and agricultural practices, and alteration of processes responsible for historic conditions (e.g., wildfire), have produced a landscape much different than what was historically present in the Ozarks. For example, prairies no longer occur on FLW, and glades and savannas are overgrown. Thus, natural communities occurring on the landscape do not reflect a healthy system. This occurrence is generally due to a loss of structure, natural processes, and invasion of both native and exotic species not belonging to the community.

Historically, the Upper Ozarks included both open park-like woodlands and dense forest cover (Biodiversity Task Force 1992). Savanna conditions occurred on broken terrain in the drier areas and consisted of oak and oak-pine stands with an open understory and a dense herbaceous ground flora of prairie grasses and wildflowers. Dense, closed canopy forests with a well developed understory occurred in the bottomlands and on adjacent slopes. Small bedrock exposed areas supported glade and cliff natural communities. The karst topography of the region created caves, sinkhole ponds, springs, and fen natural communities. Streams were cold and clear, free flowing, had a stable substrate, and were bordered by wide strips of bottomland forests.

With the exception of cave and cliff natural communities, few natural communities in the Ozarks have retained the biological integrity and diversity associated with their presettlement condition. The open savanna and dry-mesic upland forests now have a more closed canopy, a denser understory, and less herbaceous growth. Bottomland forests cleared for agricultural practices are less diverse, younger, and occupy fewer acres than historic conditions. Glades have been overgrown by the surrounding forests, and woody vegetation has become extensive. Sinkhole ponds, springs, and fens were degraded by livestock, and many no longer have the same vegetative communities. Streams have suffered from increased erosion, unstable substrate, siltation, impoundments, and loss of protective bottomland forest. The altered conditions of these landscapes resulted in a change in both plant and animal species composition, and a loss of biological diversity.

Loss of biological diversity is best addressed on the landscape rather than species scale. By restoring the landscape conditions, the framework is laid for species to increase or be reintroduced. The habitat requirements of most species lost from the landscape will be addressed through ecosystem manipulation. Those species that do not respond to landscape and natural community restoration can be dealt with individually.

Landscape Management Recommendations

Too many natural communities exist on FLW to address the biological integrity of each one. However, by combining species groups and natural communities into broad landscape associations, it is possible to assess the health and biological diversity of these associations on FLW. Landscape associations that will be discussed are:

1. *Floodplain and rivers.* Natural communities present in this category include bottomland forests and gravel wash. This category corresponds to the Riparian

Bluffs and Waterway Corridors, and portions of the Forested River Hills Physiographic Land Management Zones (Ecological Services Center n.d.).

2. *Forest and glades.* Natural communities present in this category include mesic forest, dry and dry-mesic chert forest, dry and xeric dolomite forest, and dolomite glades. This category corresponds to the Upland Forested Hills and portions of the Forested River Hills Physiographic Land Management Zones (Ecological Services Center n.d.).

3. *Savanna and open land.* Natural communities present in this category include dry chert savanna and prairie. This category corresponds to the Upland Rolling Hills and Savanna Physiographic Land Management Zones (Ecological Services Center n.d.).

4. *Other communities.* Natural communities present in this category include caves, cliffs, springs, seeps, sinkhole ponds, and wetlands. There is no corresponding Physiographic Land Management Zone.

Biological Diversity of Landscape Associations

Floodplain and rivers. With the exception of questions posed regarding species abundance of freshwater mussels in portions of Big Piney River within the boundaries of FLW, aquatic communities appear intact. Species of fish, mussels, crayfish, aquatic amphibians and reptiles, and mammals associated with streams, including common species (bleeding shiner, largescale stoneroller, green sunfish, ellipse, broken-ray mussels, spothanded crayfish, golden crayfish, bull frog, common map turtle, musk turtle, softshell turtles, muskrat) and listed species (bluestripe darter, blacknose shiner, plains topminnow, mooneye, elktoe), occur as expected. The eastern hellbender, a Missouri Watch List species, was not observed during this study, and areas on FLW do not appear to contain suitable habitat for it.

Bottomland forest is well represented on FLW and occurs extensively along the larger streams and their tributaries. As with other forested areas, due to previous land-use practices, these natural communities are not high quality. The structure is even-aged, with low tree species diversity that is relatively young. However, species of amphibians, reptiles, birds, and mammals associated with bottomland forest, including common species (pickerel frogs, green frogs, yellow-crowned night-heron, parula warblers, green herons, great blue herons, white-tailed deer, beaver) and listed species (cerulean warblers, brown creepers, red-shouldered hawks, wintering bald eagles, gray bats, Indiana bats, eastern small-footed myotis, eastern wood rat, golden mouse, and *Juglans cinerea*), occur as expected.

Forests and glades. Forest structure and composition is typical of that occurring in the Upper Ozarks. Forests are relatively even-aged and young. While the forests occurring on FLW are not examples of high quality natural communities, they offer suitable habitat for many species. Species of amphibians, reptiles, birds, and mammals associated with upland forest, include common species (southern redback salamander, eastern gray treefrog, dwarf American toad, ground skink, five-lined skink, western earth snake, western worm snake, southern coal skink, broad-winged hawk, downy woodpecker, red-eyed vireo, Kentucky warbler, big brown bat, little brown bat, striped skunk, white-footed mouse,) and listed species (ringed salamander, Cooper's hawk, sharp-shinned hawk, Indiana bat, gray bat, eastern small-footed myotis, eastern wood rat), occur as expected.

Glade communities were grouped with upland forests, since glades on FLW are relatively small openings facing south to southwest on dolomite or sandstone, and surrounded by either forest or savanna. Most of the glades on FLW have not been burned either by wild fire or prescribed fire for many years. Thus, they have been encroached upon by woody vegetation and non-native species. Common species were found as expected (eastern narrowmouth toad, prairie racerunner, northern fence lizard, field sparrow, indigo bunting, American goldfinch, white-eyed vireo, eastern cottontail). Several listed species that prefer the drier conditions of glades (*Sporabolus ozarkanus*, *Silene regia*, eastern wood rat) were discovered on FLW. Two other listed species that prefer glade habitat are the eastern collared lizard and Bachman's sparrow, neither of which were found on FLW.

Savanna and open land. Communities within this category occur on FLW, but in relatively degraded conditions with regard to age structure, canopy closure, and herbaceous understory. Additionally, several small prairies historically occurred on FLW. Species associated with savanna and prairies, including common species (eastern narrowmouth toad, ground skink, five-lined skink, red-tailed hawk, northern bobwhite, eastern wood-pewee, field sparrow, brown-headed cowbird, eastern chipmunk, striped skunk) and listed species (narrowleaf rushfoil, buffalo clover, royal catchfly, eastern wood rat), were found on FLW. Two listed species, Bachman's sparrow and loggerhead shrike, often found in savanna and open habitats, were not located on FLW during this survey.

Other communities. Many caves occur on FLW and are in relatively good condition. Species associated with caves, including common species (eastern pipistrelle, cave salamander, pickerel frogs) and listed species (Indiana bat, gray bat, eastern small-footed myotis, grotto salamander) were found on FLW.

Numerous springs and spring branches occur throughout the installation. These springs are important in providing a source of water throughout the year. Most of

the small headwater streams found on FLW are fed by springs. Aquatic life is not very diverse in these springs and was not sampled during this survey. One species listed as Rare in Missouri, the four-toed salamander, is often found in mossy beds along the flowing springs during March-April. However, surveys for this species were unsuccessful.

Many small wetlands occur throughout FLW. However, very few are representative of high quality wetlands. Even though most wetlands had been disturbed by previous land- use practices, these wetlands are important habitat components for many common species (bull frog, Fowler's toad, marbled salamander, northern water snake, red-eared slider, great blue heron, green heron, common yellowthroat, Louisiana waterthrush, mink, beaver, raccoon) and for several listed species (pied-billed grebe, marsh wren, ringed salamander).

Biological Diversity Management Recommendations

Protection, enhancement, and restoration of landscapes on FLW will meet the needs of most elements of biodiversity. As few exemplary natural communities are located on the installation, the land management staff of FLW will best be able to choose areas that will be worthwhile to manage (i.e., protect, enhance, and/or restore). Selection of areas will be based not only on their current condition, but also on the level of training that will occur on the site. Necessarily, those areas possessing a higher level of natural integrity, and used either sparingly or not at all for training, will be the best suited for management and will likely offer the highest probability of success.

Floodplain and rivers.

1. Maintain and enhance existing bottomland forests.

   Status: Bottomland forest is extensive on FLW; however, these forests are relatively even-aged and do not exhibit the mosaic of structure associated with bottomland forests. Bottomland forest provides nesting and wintering roosting sites for bald eagles. As nesting bald eagles are increasing in Missouri, and have nested just north of FLW on the Gasconade River, it is likely that bald eagles may eventually nest on FLW. The riparian corridor associated with bottomland forest also provides foraging areas for gray bats and Indiana bats. Bottomland forests help improve stream quality by minimizing streambank erosion and providing shade to aquatic communities.

Strategies:

— Use uneven-aged timber harvest to remove or decrease the frequency of undesirable species (i.e., species not associated with bottomland forest natural communities).
— Reduce or eliminate training maneuvers in bottomland forests. This will reduce soil erosion.
— Continue practice of streambank soil erosion control in areas requiring such management.

2. Maintain vegetative connectivity between river and upland forests.

Status: Primarily intact on FLW. Connectivity between river and upland forests provides travel corridors to and from the river. These travel corridors benefit many species. For example, they provide cover for foraging Endangered bats and travel corridors for animal and plant dispersal that is necessary in preserving heterogeneity.

Strategy:

— Establish, improve, and maintain forested strips, at least 200 ft wide, between river and upland forests.

Forests and glades.

1. Reduce forest fragmentation and improve forest quality.

Status: Existing forests are fragmented due to previous land use practices. A reduction in forest fragmentation will increase the habitat of forest interior neotropical birds that are area sensitive (broad-winged hawk, yellow-throated warbler, ovenbird, hooded warbler [Herkert et al. 1993]). Forest fragmentation leads to poor nesting conditions for species of birds requiring large tracts of forest for successful nesting. These species are more sensitive to the higher levels of predation and nest parasitism from cowbirds when forest blocks are small.

Strategies:

— Increase uneven-aged forest management techniques in the Upland Forested Hills and suitable portions of the Forested River Hills Physiographic Land Management Zone. Use single tree/small group selection cutting rather than large clearcuts. This will reduce forest fragmentation and more closely represent natural forces that shape a forest (i.e., disease, fire, wind). Leave snags, fallen logs, and old trees throughout the forest.

- Designate a minimum of 10 percent of the forest as old growth. Choose sites that contain mature second growth and some trees greater than 60 years old, and do not harvest. Select areas within all forest natural community types (i.e., dry chert forest, dry mesic chert forest, etc.).
- Reduce plowing and mowing of fire lines as much as feasible. Fire lines promote the invasion of exotic or other undesirable plants, increase erosion, and fragment the landscape. If possible, establish natural fire lines using landscape features that serve as fire breaks (i.e., bluffs, streams, roads).
- Reduce the number of roads existing on FLW. Allow some of the older, rarely used timber harvest roads to grow over. This practice will reduce forest fragmentation, create a contiguous forest, and benefit forest interior species.
- Establish and maintain forest landscapes that contain a mosaic of representative natural communities and designate areas as off-limits to land disturbance practices. Designate buffer zones that capture transitional areas and help minimize disturbance to core natural communities. This practice protects forest interior birds.

2. Restore and maintain glades in a natural state.

Status: Glades are prevalent throughout FLW, but are generally overgrown with woody vegetation. Open glades will benefit plants (e.g., *Silene regia, Sporabolus ozarkanus,* and species of *Echinacea* and *Liatris*) and animals (e.g., prairie racerunner, narrowmouth toad) associated with glades in the Upper Ozarks. Current management of Laughlin glade (prescribed fire and removal of woody vegetation) is an example of good glade management.

Strategies:

- Continue to use prescribed fires that mimic the natural fire regime in frequency, duration, temperature, and seasonality. Vary the fire regime depending upon the current condition and type of the natural community. Certain areas that are overgrown may initially need to be burned more frequently. Continue to incorporate fires started during shooting and ordnance exercises into the prescribed burn regime. This practice injects an amount of unpredictability to the fires, which more closely mimics natural fire occurrence.
- Remove encroaching vegetation, both exotic and weedy vegetation, mechanically or through prescribed fires on existing glades (e.g., remove cedars from glade openings and initiate a prescribed burn plan that periodically removes exotic and other vegetation uncharacteristic of the glade).

Savanna and open lands. Restore and maintain open conditions associated with savanna and prairie on FLW.

Status: Savanna exists throughout FLW; historic prairie is gone. Dry and dry-mesic chert savanna are the dominant natural communities associated with the savanna landscape of FLW. However, most of the existing savanna communities are not very old and are degraded due to previous land use. Ongoing savanna and prairie management on FLW is occurring in an attempt to improve the current condition of these communities. Improving savanna and prairie will increase the amount of habitat for species preferring more open, herbaceous conditions (e.g., loggerhead shrike, field sparrow, Bewick's wren, deer mouse, prairie vole, northern scarlet snake, five-lined skink).

Strategies:

— Continue to use prescribed burns that mimic the natural fire regime in frequency, duration, temperature, and seasonality. Vary the fire regime depending upon the current condition and type of the natural community. Certain areas that are overgrown initially may need to be burned more frequently. Continue to incorporate fires started during shooting and ordnance exercises into the prescribed burn regime. This practice injects an amount of unpredictability to the fires, which more closely mimics natural fire occurrence.

— Increase use of uneven-aged forest management techniques in the Upland Rolling Hills and Savanna Physiographic Land Management Zone. Use single tree/small group selection cutting rather than large clearcuts. This reduces fragmentation, and more closely represents natural forces that shape a forest or savanna (i.e., disease, fire, wind). Leave snags, fallen logs, and old trees throughout the area.

Other communities.

1. Protect karst landscape features: caves, sinkholes, springs, and seeps.

Status: Certain of the karst features have been heavily disturbed by previous land use. Protection of these features will maintain the biological diversity associated with these communities (e.g., cave salamanders, grotto salamanders, ringed salamanders, pickerel frogs).

Strategies:

— Maintain vegetation surrounding these features in a natural condition. This practice will minimize erosion and other types of community degradation.

— Monitor cave use to determine level of disturbance. Sign or gate caves to minimize disturbance.

2. Maintain integrity of existing wetlands.

Status: Numerous wetlands occur on FLW; however, many have been disturbed by previous and ongoing land-use practices. Wetlands provide breeding areas for amphibians and reptiles (e.g., spotted salamander, spring peeper, red-eared slider) and birds (Louisiana waterthrush, common yellowthroat).

Strategies:
— Establish buffer zones of natural vegetation around wetlands and waterways to protect water quality and reduce soil erosion.
— Minimize training activities within erosional zones of wetlands.

Management Recommendations for Species

Gray Bat

Current management practices: Adequate. FLW is presently implementing MDC management guidelines.

Note: The gray bat maternity site is heavily visited by pot-hunters. This activity may disturb female bats and their young, causing young bats to fall off of their mothers.

Recommendations: Frequent inspection of the cave entrance to determine prevalence of pot-hunters and whether this activity is disturbing bats using the cave. Construction of a cave gate or fence should be considered to restrict access to the cave if disturbance levels are high.

Indiana Bat

Current management practices: Adequate. FLW is presently implementing MDC management guidelines.

Note: Previously, Indiana bats were not known to use FLW during the summer breeding months. Mist-net surveys in 1994 captured three Indiana bats (one pregnant, one lactating, and one male) on FLW; thus indicating a small reproducing population on FLW.

Recommendations: Further studies should be completed to determine status, location of maternity roosts, and foraging areas of reproductive Indiana bats on the installation. If a maternity roost is discovered, guidelines, much like those restricting activity around endangered bat cave entrances already in use on FLW, should be developed and enacted.

Timber harvest in areas where maternity roosts are found should be reduced. If the area must be harvested, uneven-age management should be used. Snags and trees with exfoliating bark that are greater than 9-in. DBH, and especially those trees greater than 21-in. DBH, should not be harvested, particularly during the Indiana bat reproductive period (1 April to 15 September). If the crown canopy is dense, selective cutting of trees may actually improve conditions of certain roost trees by increasing the amount of solar radiation, and thereby increasing the temperature under the exfoliating bark.

Bald Eagle

Current management practices: None. Census of wintering bald eagles conducted in cooperation with MDC.

Note: Bald eagles have not attempted to nest within the boundaries of FLW. Bald eagles have successfully nested on nearby Gasconade River and attempted to nest south of FLW on Big Piney River. It is likely that, as the number of bald eagles increases, nesting attempts will be made within FLW. Wintering bald eagles occur along Big Piney River and Roubidoux Creek.

Recommendations: Should a nesting attempt occur on FLW, special management restrictions should be enacted around the nest. Restrictions recommended by MDC are different for every nest but consist primarily of a "No Entrance Zone" of approximately 250 yd during the nesting period, which also carries with it a stipulation that there be no land disturbance within the 250-yd zone year long. This restriction is removed once a nest has not been used for 3 successive years. Additionally, nests that are located near airports have a "No-fly Zone" during the nesting period. The size of this zone varies, but it is used primarily to restrict low-flying aircraft from getting too near a nesting pair of bald eagles. If a nesting attempt is noted on FLW, contact an MDC ornithologist.

Management Recommendations for Falls Hollow Sandstone Glades

Current management practices: Inadequate.

Note: Current management includes infrequent prescribed burns and mechanical removal of eastern red cedar.

Recommendations: Management strategies designed to decrease the amount of erosion coming from Range 22 (which might include removal of one or two of the eastern-most firing lines and planting native vegetation along the road bordering the west side of the glade), remove exotic and weedy vegetation, and enhance the surrounding sandstone forest, would greatly improve the quality of Falls Hollow sandstone glades. Implement a burn regime that mimics the natural fire regime. Post signs prohibiting parking or crossing the glade with motorized vehicles.

General Management Guidelines

1. Consider designating certain areas of FLW as low impact, where military activities and human disturbances are kept to a minimum. These areas should represent a mosaic of natural community types occurring on FLW, and incorporate populations of rare and endangered plants, animals, and high quality communities (or at least the potential of restoring to high quality). Timber harvest and other land management techniques should be used as needed to maintain and enhance the natural communities present. Setting aside areas as a "reserve" would provide protection to elements of biodiversity present on these areas. If a number of such areas are established that represent all, or much, of the biodiversity occurring on FLW, then the biodiversity of FLW has been protected. Other areas could then be used for training purposes without the loss of important biodiversity elements. This practice could also be thought of as setting aside a percentage of all natural communities present.

2. Revegetate cleared areas using native vegetation appropriate for the FLW region. If an area must be immediately planted to stop or minimize soil erosion, use a mixture of annual rye grass (which will not permanently establish) and native vegetation.

3. Reduce the incidence of soil erosion along waterways, wetlands, roads, and other areas by minimizing soil disturbance and revegetating with native plants. If necessary, use hay bales in areas experiencing high soil erosion into waterways, until erosion can be reduced and stopped. For example, place hay bales in the drainage running onto Falls Hollow sandstone glade from Range 22. This practice will slow movement of soil, litter, and other debris onto the glade.

4. Improve low water crossings that often cause soil erosion. Whenever possible, refrain from using gravel as a crossing medium. Placing large amounts of gravel in streams changes stream hydrology by stopping water and causing new

channels to form. Eventually, gravel is washed downstream and must be replaced at the crossing. Specifically, place a permanent low-water box culvert crossing over Roubidoux Creek at the Crossroads. The gravel and sand portion of the current crossing is washed away every few years and impedes water flow.

5. Continue using the LCTA program to look at the effects of training to the landscape. Establish monitoring programs to determine the efficacy of management practices on the ecosystems and the natural communities within, including the effects on plant and animal populations. Modify management techniques as needed.

Table 1. Federally and state-listed species for which surveys were conducted on Fort Leonard Wood, Pulaski Co., MO, 1993–1995.

SCIENTIFIC NAME[1]	COMMON NAME[1]	STATUS FEDERAL[2]	STATUS STATE[2]
Vascular Plants			
Agalinis purpurea	Purple false foxglove		WL
Agalinis skinneriana	A false foxglove	C2	WL
Agrimonia gryposepala	Tall agrimony		SU
Alopecurus aequalis	Floating foxtail		R
Armoracia lacustris	Lake cress	3C	SU
Aster furcatus	Forked aster	C2	WL
Aster macrophyllus	Big-leaved aster		E
Berberis canadensis	American barberry		R
Bromus latiglumis	Brome grass		SU
Calamagrostis porteri spp. *insperata*	Reed bent grass	C2	R
Carex alata	Broadwing sedge		WL
Carex buxbaumii	Brown bog sedge		R
Carex comosa	Bristly sedge		R
Carex conoidea	Field sedge		E
Carex fissa var. fissa	A sedge	C2	SU
Carex laevivaginata	Smooth-sheath sedge		R
Carex straminea	Straw sedge		SU
Carex stricta	Tussock sedge		R
Carex triangularis	Triangular sedge		E
Carex trichocarpa	Hairy-fruited sedge		R
Carex virescens	Ribbed sedge		WL
Clematis viorna	A leather flower		E
Crotonopsis linearis	Narrowleaf rushfoil		SU
Cypripedium reginae	Showy lady's slipper		WL
Desmodium viridiflorum	Velvety tick trefoil		E
Dichanthelium leibergii	Panic grass		SU
Dryopteris carthusiana	Spinulose shield fern		E
Dryopteris goldiana	Goldie's fern		R
Elatine triandra	Waterwort		E
Glyceria acutiflora	Sharp-scaled manna grass		R
Heuchera parviflora var. *parviflora*	Little leaved alum root		E
Juglans cinerea	Butternut	C2	WL
Malaxis unifolia	Green adder's mouth		SU

SCIENTIFIC NAME[1]	COMMON NAME[1]	STATUS FEDERAL[2]	STATUS STATE[2]
Matelea baldwyniana	Baldwin's milkvine	C2	SU
Najas gracillima	Thread-like naiad		E
Nemastylis nuttallii	Celestial lily		SU
Plantago cordata	Heart-leaved plantain	3C	W
Potamogeton pusillus var. *pusillus*	Slender pondweed		E
Scirpus torreyi	Torrey's bulrush		E
Scleria ciliata var. *ciliata*	Hairy nut-rush		SU
Sedum ternatum	Wood stonecrop		WL
Silene regia	Royal catchfly	3C	WL
Sisyrinchium atlanticum	Eastern blue-eyed grass		R
Smallanthus uvedalius	Yellow-flowered leafcup		WL
Spiranthes lacera var. *gracilis*	Slender ladies' tresses		WL
Spiranthes lucida	Shining ladies'tresses		R
Spiranthes ovalis var. *erostellata*	Oval ladies' tresses		R
Sporobolus ozarkanus	Bald grass	3C	SU
Torreyochloa pallida	Pale manna grass		E
Trifolium reflexum var. *reflexum*	Buffalo clover		SU
Trifolium stolonifera	Running buffalo clover	E	E
Triosteum angustifolium var. *earnesii*	Yellow-flowered horse gentian		
Waldsteinia fragarioides ssp. *fragarioides*	Barren strawberry		R
Zigadenus elegans	White camus		R
Mollusks			
Alasmidonta marginata	Elktoe	C2	SU
Cumberlandia monodonta	Spectaclecase	C2	WL
Fish			
Fundulus sciadicus	Plains topminnow	C2	SU
Hiodon tergisus	Mooneye		R
Notropis heterolepis	Blacknose shiner		R
Percina cymatotaenia	Bluestripe darter	C2	R
Amphibians			
Ambystoma annulatum	Ringed salamander		WL

SCIENTIFIC NAME[1]	COMMON NAME[1]	STATUS FEDERAL[2]	STATUS STATE[2]
Cryptobranchus a. alleganiensis alleganiensiss	Eastern hellbender	C2	WL
Hemidactylium scutatum	Four-toed salamander		R
Typhlotriton spelaeus	Grotto salamander		WL
Reptiles			
Cemophora coccinea copei	Northern scarlet snake		R
Crotaphytus collaris collaris	Eastern collared lizard		WL
Birds			
Accipiter cooperii	Cooper's hawk		R
Accipiter striatus	Sharp-shinned hawk		R
Aimophila aestivalis	Bachman's sparrow	C2	E
Ammodramus henslowii	Henslow's sparrow	C2	R
Ardea herodias	Great blue heron rookery		Common
Buteo lineatus	Red-shouldered hawk		WL
Certhia americana	Brown creeper		SU
Dendroica cerulea	Cerulean warbler	C2	WL
Dendroica pensylvanica	Chestnut-sided warbler		SU
Haliaeetus leucocephalus	Bald eagle	T	E
Lanius ludovicianus	Loggerhead shrike	C2	WL
Limnothlypis swainsonii	Swainson's warbler		E
Nycticorax nycticorax	Black-crowned night heron		R
Thryomanes bewickii	Bewick's wren		WL
Tyto alba	Barn owl		R
Vireo bellii	Bell's vireo		WL

SCIENTIFIC NAME[1]	COMMON NAME[1]	STATUS FEDERAL[2]	STATUS STATE[2]

[1]Nomenclature follows that of Yatskievych and Turner (1990) for plants, Turgeon et al. (1988) with modifications as suggested by Williams et al. (1992) for mollusks, Robins et al. (1991) for fish, Conant and Collins (1991) for amphibians and reptiles, and American Ornithologists' Union (1983) with occasional updates for birds.

[2]Rare and Endangered Species Checklist of Missouri (1995):

Federal Categories

E	=	*Endangered*	*Endangered throughout range.*
T	=	*Threatened*	*Threatened throughout range.*
C2	=	*Candidate*	*Taxa is candidate for Federal listing. No longer a valid category.*
3C	=	*Former Candidate*	*Taxa proved to be more abundant or widespread.*

Missouri Categories

E	=	*Endangered*	*Survival of species in Missouri is in immediate jeopardy.*
R	=	*Rare*	*Present in small numbers in Missouri. If environment worsens, status in Missouri could deteriorate to Endangered.*
SU	=	*Status Undetermined*	*May be Rare or Endangered, but not enough information is available to determine the status.*
WL	=	*Watch List*	*Not currently Rare or Endangered, but has a restricted distribution or has experienced sufficient decline to indicate it may soon become Rare or Endangered.*

Table 2. Freshwater mussel species from Big Piney River (B) and Roubidoux Creek (R), MO.

SCIENTIFIC NAME[1]	COMMON NAME	Oesch (1984)	Warren (1993)	Buchanan (Unpubl.)	This Study
Margaritiferidae					
Cumberlandia monodonta[*,**] (Federal–Formerly C2; MO–Watch List)	Spectaclecase			B	Alive-B[2] Dead-R
Unionidae					
Actinonaias ligamentina[**]	Mucket	B	B	B	Alive-B Dead-R
Alasmidonta marginata (Federal–Formerly C2; MO–Status Undetermined)	Elktoe		B,R	B	Alive-B,R
Alasmidonta viridis	Slippershell mussel		B,R		
Amblema plicata[*]	Threeridge		R	B	Alive-B Dead-R
Cyclonaias tuberculata[*,**]	Purple wartyback			B	Alive-B Dead-R
Elliptio dilatata	Spike	B	B,R	B	Alive-B,R
Fusconaia flava	Wabash pigtoe	B,R	B,R	B	Alive-B,R
Fusconaia ozarkensis[*,**,3]	Ozark pigtoe				Alive[3]-B,R
Lampsilis cardium	Plain pocketbook	B	B,R	B	Alive-B,R
Lampsilis siliquoidea (=radiata)	Fatmucket or eastern lampmussel		B,R		Alive-B,R
Lampsilis reeviana brittsi	Northern broken-ray	B	B,R	B	Alive-B,R
Lampsilis reeviana brevicula	Ozark broken-ray	B			Alive-B
Lampsilis teres[*]	Yellow sandshell				Dead-B
Lasmigona costata	Fluted-shell	B	B		Alive-B
Leptodea fragilis[*]	Fragile papershell			B	Dead-B
Ligumia recta	Black sandshell	B			Alive-B
Ligumia subrostrata	Pondmussel	B	B		Alive-B
Obliquaria reflexa[*]	Threehorn wartyback				Dead-B
Pleurobema coccineum	Round pigtoe	R	B	B	Alive-B,R
Potamilus alatus[**]	Pink heelsplitter	B			Alive-B Dead-R
Ptychobranchus occidentalis[*] (Federal–Formerly C2; MO–Watch List)	Ouachita kidneyshell				Dead-B
Pyganodon (=Anodonta) *grandis*	Giant floater	B	R	B	Alive-B
Quadrula metanevra[**]	Monkeyface	B			Alive-B,R
Quadrula pustulosa[*]	Pimpleback				Alive-B
Strophitus undulatus	Squawfoot	B	B,R	B	Dead-B

SCIENTIFIC NAME[1]	COMMON NAME	Oesch (1984)	Warren (1993)	Buchanan (Unpubl.)	This Study
Tritogonia verrucosa[*,**]	Pistolgrip				Alive-B Dead-R
Utterbackia (=Anodonta) *imbecillis*[*]	Paper pondshell				Alive-B
Venustaconcha ellipsiformis	Ellipse	B	B,R	B	Alive-B,R
Corbicula fluminea[*,**] (introduced)	Asiatic clam				Alive-B,R
Total Number of Species	B: 28 + clam R: 18 + clam	B: 14 R: 2	B: 13 R: 11	B: 14	B: 27+clam R: 15+clam

Note: Sampling for this study occurred between October 1993 and October 1995.
*New record for Big Piney River.
**New record for Roubidoux Creek.
[1]Nomenclature follows Turgeon et al. (1988) with modifications as suggested by Williams et al. (1992). Nomenclature used by Oesch (1984) is included in parentheses for cross-referencing.
[2]Found alive several miles downstream of Fort Wood at Devil's Elbow and Interstate 44.
[3]Tentative identification. Tissue needed for positive identification. Species not included in Total Number of Species.

Table 3. Species of freshwater mussels observed at each study site on the Big Piney River, Pulaski and Phelps counties, MO, between October 1993 and October 1995.

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE						
		BPM 01	BPM 02	BPM 03	BPM 04	BPM 05	BPM 06	BPM 07*
Actinonaias ligamentina	Mucket	X	303		23	214	125	3
Alasmidonta marginata	Elktoe		1					
Amblema plicata	Threeridge		5		1	5	4	
Cumberlandia monodonta	Spectaclecase	X	X		X			
Cyclonaias tuberculata	Purple wartyback	X	10		8	18	16	
Elliptio dilatata	Spike	X	4		2	4	8	
Fusconaia flava	Wabash pigtoe		1	1	1	1	2	1
Fusconaia ozarkensis[2]	Ozark pigtoe		37[2]					
Lampsilis cardium	Plain pocketbook	X	3		2	5		
Lampsilis reeviana	Northern broken-ray	X	10	2	5	9	15	4
Lampsilis siliquoidea (=radiata)	Fatmucket	X						
Lampsilis teres	Yellow sandshell							
Lasmigona costata	Fluted-shell	X	1	1		6		
Leptodea fragilis	Fragile papershell							
Ligumia recta	Black sandshell					X		
Ligumia subrostrata	Pondmussel							
Obliquaria reflexa	Threehorn wartyback							
Pleurobema coccineum	Round pigtoe	X	10		2	11	16	
Potamilus alatus	Pink heelsplitter							
Ptychobranchus occidentalis	Ouachita kidneyshell	X						
Pyganodon (=Anodonta) grandis	Giant floater		1					
Quadrula metanevra	Monkeyface	X	9	2	2	34	6	
Quadrula pustulosa	Pimpleback	X	1			3	6	
Strophitus undulatus	Squawfoot	X						
Tritogonia verrucosa	Pistolgrip		3	2		X	4	
Utterbackia (=Anodonta) *imbecillis*	Paper pondshell							
Venustaconcha ellipsiformis	Ellipse	X	12	1	12	17	16	2
Corbicula fluminea (introduced)	Asiatic clam	A	A	A	A	A	A	A
Total Number of Species	26 + clam	15	17	7	12	15	12	5

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE						
		BPM 08	BPM 09	BPM 10	BPM 11	BPM 12	BPM 13	BPM 14
Actinonaias ligamentina	Mucket	X				2	14	1
Alasmidonta marginata	Elktoe							
Amblema plicata	Threeridge						X	
Cumberlandia monodonta	Spectaclecase							
Cyclonaias tuberculata	Purple wartyback						X	
Elliptio dilatata	Spike					X	5	X
Fusconaia flava	Wabash pigtoe						1	X
Fusconaia ozarkensis[2]	Ozark pigtoe							
Lampsilis cardium	Plain pocketbook					X	X	X
Lampsilis reeviana	Northern broken-ray					X	10	
Lampsilis siliquoidea (=radiata)	Fatmucket						1	X
Lampsilis teres	Yellow sandshell							
Lasmigona costata	Fluted-shell						X	
Leptodea fragilis	Fragile papershell							
Ligumia recta	Black sandshell							
Ligumia subrostrata	Pondmussel							
Obliquaria reflexa	Threehorn wartyback							
Pleurobema coccineum	Round pigtoe							
Potamilus alatus	Pink heelsplitter						X	
Ptychobranchus occidentalis	Ouachita kidneyshell							
Pyganodon (=Anodonta) grandis	Giant floater							
Quadrula metanevra	Monkeyface							X
Quadrula pustulosa	Pimpleback						X	
Strophitus undulatus	Squawfoot							
Tritogonia verrucosa	Pistolgrip						1	
Utterbackia (=Anodonta) imbecillis	Paper pondshell							
Venustaconcha ellipsiformis	Ellipse						1	
Corbicula fluminea (introduced)	Asiatic clam					X	A	A
Total Number of Species	26 + clam	1	0	0	0	5	14	7

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE						
		BPM 15	BPM 16	BPM 17	BPM 18	BPM 19	BPM 20	BPM 21
Actinonaias ligamentina	Mucket	2	3	X	X	1		1
Alasmidonta marginata	Elktoe							
Amblema plicata	Threeridge	X	X		X			
Cumberlandia monodonta	Spectaclecase						X	
Cyclonaias tuberculata	Purple wartyback				X			
Elliptio dilatata	Spike	X	X		X	X		
Fusconaia flava	Wabash pigtoe		X			X		
Fusconaia ozarkensis[2]	Ozark pigtoe							
Lampsilis cardium	Plain pocketbook	X	X		X		X	X
Lampsilis reeviana	Northern broken-ray	X	X	X			3	X
Lampsilis siliquoidea (=radiata)	Fatmucket					X		
Lampsilis teres	Yellow sandshell							
Lasmigona costata	Fluted-shell		X					
Leptodea fragilis	Fragile papershell							
Ligumia recta	Black sandshell							
Ligumia subrostrata	Pondmussel							
Obliquaria reflexa	Threehorn wartyback							
Pleurobema coccineum	Round pigtoe		X		X	X		X
Potamilus alatus	Pink heelsplitter					1		
Ptychobranchus occidentalis	Ouachita kidneyshell							
Pyganodon (=Anodonta) grandis	Giant floater							
Quadrula metanevra	Monkeyface		X		X	X		1
Quadrula pustulosa	Pimpleback		X		X	X		
Strophitus undulatus	Squawfoot							
Tritogonia verrucosa	Pistolgrip		X					
Utterbackia (=Anodonta) imbecillis	Paper pondshell							
Venustaconcha ellipsiformis	Ellipse		1	1				
Corbicula fluminea (introduced)	Asiatic clam	X	A	X	X	A	X	A
Total Number of Species	26 + clam	6	13	4	9	9	4	6

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE						
		BPM 22	BPM 23	BPM 24	BPM 25	BPM 26	BPM 27	BPM 28A
Actinonaias ligamentina	Mucket	X	13	X	X			
Alasmidonta marginata	Elktoe							
Amblema plicata	Threeridge			X				14
Cumberlandia monodonta	Spectaclecase							
Cyclonaias tuberculata	Purple wartyback							
Elliptio dilatata	Spike	X	1	X				
Fusconaia flava	Wabash pigtoe	X	3	X			X	2
Fusconaia ozarkensis[2]	Ozark pigtoe							
Lampsilis cardium	Plain pocketbook		1	X	X		X	
Lampsilis reeviana	Northern broken-ray	X	14	1			X	
Lampsilis siliquoidea (=radiata)	Fatmucket	1		1				41
Lampsilis teres	Yellow sandshell							
Lasmigona costata	Fluted-shell	X						
Leptodea fragilis	Fragile papershell							
Ligumia recta	Black sandshell							
Ligumia subrostrata	Pondmussel			X				41
Obliquaria reflexa	Threehorn wartyback							
Pleurobema coccineum	Round pigtoe	X	1	X				
Potamilus alatus	Pink heelsplitter							20
Ptychobranchus occidentalis	Ouachita kidneyshell							
Pyganodon (=Anodonta) grandis	Giant floater							25
Quadrula metanevra	Monkeyface							
Quadrula pustulosa	Pimpleback		1					
Strophitus undulatus	Squawfoot							
Tritogonia verrucosa	Pistolgrip							
Utterbackia (=Anodonta) imbecillis	Paper pondshell							2
Venustaconcha ellipsiformis	Ellipse	1	4	X				
Corbicula fluminea (introduced)	Asiatic clam	A	A	X			A	X
Total Number of Species	26 + clam	9	9	11	2	0	4	8

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE						
		BPM 28B	BPM 28C	BPM 28D	BPM 29	BPM 30	BPM 31	BPM 32
Actinonaias ligamentina	Mucket				X	1	X	X
Alasmidonta marginata	Elktoe							
Amblema plicata	Threeridge	4		1			X	
Cumberlandia monodonta	Spectaclecase						X	
Cyclonaias tuberculata	Purple wartyback							
Elliptio dilatata	Spike					X	X	
Fusconaia flava	Wabash pigtoe				X	X	X	
Fusconaia ozarkensis[2]	Ozark pigtoe				X?[2]			
Lampsilis cardium	Plain pocketbook				1	2	X	X
Lampsilis reeviana	Northern broken-ray				X		X	X
Lampsilis siliquoidea (=radiata)	Fatmucket	9	3	5	X		X	
Lampsilis teres	Yellow sandshell	X						
Lasmigona costata	Fluted-shell							
Leptodea fragilis	Fragile papershell							
Ligumia recta	Black sandshell							
Ligumia subrostrata	Pondmussel	7	6	2	2	X		
Obliquaria reflexa	Threehorn wartyback							
Pleurobema coccineum	Round pigtoe							
Potamilus alatus	Pink heelsplitter	3	3	4	X		X	X
Ptychobranchus occidentalis	Ouachita kidneyshell							
Pyganodon (=Anodonta) grandis	Giant floater	11	11		X	1		
Quadrula metanevra	Monkeyface					X		
Quadrula pustulosa	Pimpleback							
Strophitus undulatus	Squawfoot							
Tritogonia verrucosa	Pistolgrip					X		
Utterbackia (=Anodonta) imbecillis	Paper pondshell		1					
Venustaconcha ellipsiformis	Ellipse							
Corbicula fluminea (introduced)	Asiatic clam	X	X				X	A
Total Number of Species	26 + clam	7	6	4	8	8	10	5

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE						
		BPM 33	BPM 34	BPM 35	BPM 36	BPM 37	BPM 38	BPM 39
Actinonaias ligamentina	Mucket	49	1	18	100	58		
Alasmidonta marginata	Elktoe					X		
Amblema plicata	Threeridge	9	1	28	2	8		
Cumberlandia monodonta	Spectaclecase				X	X		
Cyclonaias tuberculata	Purple wartyback	1			3	X		
Elliptio dilatata	Spike	X	X	1	3	1		
Fusconaia flava	Wabash pigtoe	X	X	1	12	8		
Fusconaia ozarkensis[2]	Ozark pigtoe					X?[2]		
Lampsilis cardium	Plain pocketbook	3	X	X	3	1		
Lampsilis reeviana	Northern broken-ray	X	X		2	1		
Lampsilis siliquoidea (=radiata)	Fatmucket	1	X	1	3	X		
Lampsilis teres	Yellow sandshell							
Lasmigona costata	Fluted-shell				1			
Leptodea fragilis	Fragile papershell					X		
Ligumia recta	Black sandshell				X	X		
Ligumia subrostrata	Pondmussel			X				
Obliquaria reflexa	Threehorn wartyback					X		
Pleurobema coccineum	Round pigtoe	5		2	18	X		5
Potamilus alatus	Pink heelsplitter		X	2	X	1		
Ptychobranchus occidentalis	Ouachita kidneyshell							
Pyganodon (=Anodonta) grandis	Giant floater			2				
Quadrula metanevra	Monkeyface	20	X		11	3		
Quadrula pustulosa	Pimpleback	1		1	4	1		
Strophitus undulatus	Squawfoot					X		
Tritogonia verrucosa	Pistolgrip			X	X	2		
Utterbackia (=Anodonta) imbecillis	Paper pondshell							
Venustaconcha ellipsiformis	Ellipse	1	X		1	X		
Corbicula fluminea (introduced)	Asiatic clam	A	A	A	A	A		
Total Number of Species	26 + clam	13	11	13	18	21	0	1

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE		
		BPM 40	BPM 41	BPM 42
Actinonaias ligamentina	Mucket	X	25	23
Alasmidonta marginata	Elktoe			
Amblema plicata	Threeridge	X	15	5
Cumberlandia monodonta	Spectaclecase		X	X
Cyclonaias tuberculata	Purple wartyback	X	3	X
Elliptio dilatata	Spike	X	X	2
Fusconaia flava	Wabash pigtoe	X	2	2
Fusconaia ozarkensis[2]	Ozark pigtoe			
Lampsilis cardium	Plain pocketbook	X	4	2
Lampsilis reeviana	Northern broken-ray		X	3
Lampsilis siliquoidea (=radiata)	Fatmucket		3	
Lampsilis teres	Yellow sandshell			
Lasmigona costata	Fluted-shell		1	2
Leptodea fragilis	Fragile papershell			
Ligumia recta	Black sandshell	X	1	1
Ligumia subrostrata	Pondmussel			
Obliquaria reflexa	Threehorn wartyback			
Pleurobema coccineum	Round pigtoe	X	1	2
Potamilus alatus	Pink heelsplitter	X	X	2
Ptychobranchus occidentalis	Ouachita kidneyshell			
Pyganodon (=Anodonta) grandis	Giant floater	X	1	
Quadrula metanevra	Monkeyface	X	X	X
Quadrula pustulosa	Pimpleback	X	2	2
Strophitus undulatus	Squawfoot			
Tritogonia verrucosa	Pistolgrip	X	2	4
Utterbackia (=Anodonta) imbecillis	Paper pondshell			
Venustaconcha ellipsiformis	Ellipse	X	1	3
Corbicula fluminea (introduced)	Asiatic clam	X	A	A
Total Number of Species	26 + clam	15	19	17

Note: Sites 7 to 34 are located either within FLW or directly adjacent to FLW. (Numbers indicate live specimens found at the site, an "X" represents one or more dead specimens, and an "A" indicates live specimens were found and not counted.

[1]Nomenclature follows that of Turgeon et al. (1988) with modifications as suggested by Williams et al. (1992). Nomenclature used by Oesch (1984) is included in parentheses for cross-referencing.

[2]Tentative identification. Tissue needed for positive identification; unfortunately, tissue was not preserved. Species not included in Total Number of Species.

Table 4. Summary of freshwater mussels found in the Big Piney River, Pulaski and Phelps counties, MO, between October 1993 and October 1995.

		Live Specimens				Site Frequency					
SCIENTIFIC NAME[1]	COMMON NAME[1]	No. Found on FLW[2]	% of FLW Total	Total Number Found	% of All Live Spec.	No. of Sites Where Found	No. of Sites Where Found Live	% of All Sites Found w/Live Spec.	No. Sites Where Found on FLW	No. of Sites Where Found Live FLW	% of Sites Where Found Live on FLW
Actinonaias ligamentina	Mucket	91	21.31	980	53.41	31	21	50.00	20	12	42.86
Alasmidonta marginata	Elktoe	0	0.00	1	0.05	2	1	2.38	0	0	0.00
Amblema plicata	Threeridge	29	6.79	102	5.56	19	12	28.57	9	3	10.71
Cumberlandia monodonta	Spectaclecase	0	0.00	0	0.00	9	0	0.00	2	0	0.00
Cyclonaias tuberculata	Purple wartyback	1	0.23	59	3.22	13	7	16.67	3	1	3.57
Elliptio dilatata	Spike	27	6.32	52	2.83	25	10	23.81	14	2	7.14
Fusconaia flava	Wabash pigtoe	7	1.64	38	2.07	26	14	33.33	15	4	14.29
Fusconaia ozarkensis[3]	Ozark pigtoe	0	--	3	--	3	1	--	1	0	--
Lampsilis cardium	Plain pocketbook	7	1.64	27	1.47	28	11	26.19	18	4	14.29
Lampsilis reeviana	Northern broken-ray	22	5.15	69	3.76	17	13	30.95	17	5	17.86
Lampsilis siliquoidea (=radiata)	Fatmucket	62	14.52	69	3.76	15	8	19.05	10	5	17.86
Lampsilis teres	Yellow sandshell	0	0.00	0	0.00	1	0	0.00	1	0	0.00
Lasmigona costata	Fluted-shell	0	0.00	12	0.65	10	6	14.29	3	0	0.00
Leptodea fragilis	Fragile papershell	0	0.00	0	0.00	1	0	0.00	0	0	0.00
Ligumia recta	Black sandshell	0	0.00	2	0.11	6	2	4.76	0	0	0.00
Ligumia subrostrata	Pondmussel	58	13.58	58	3.16	5	2	4.76	5	2	7.14
Obliquaria reflexa	Threehorn wartyback	0	0.00	0	0.00	1	0	0.00	0	0	0.00
Pleurobema coccineum	Round pigtoe	6	1.41	73	3.98	20	11	26.19	8	2	7.14

		Live Specimens				Site Frequency					
SCIENTIFIC NAME[1]	COMMON NAME[1]	No. Found on FLW[2]	% of FLW Total	Total Number Found	% of All Live Spec.	No. of Sites Where Found	No. of Sites Where Found Live	% of All Sites Found w/Live Spec.	No. Sites Where Found on FLW	No. of Sites Where Found Live FLW	% of Sites Where Found Live on FLW
Potamilus alatus	Pink heelsplitter	31	7.26	36	1.96	13	5	11.90	7	2	7.14
Ptychobranchus occidentalis	Ouachita kidneyshell	0	0.00	0	0.00	1	0	0.00	0	0	0.00
Pyganodon (=Anodonta) grandis	Giant floater	48	11.24	52	2.83	7	5	11.90	3	2	7.14
Quadrula metanevra	Monkeyface	21	4.92	88	4.80	19	9	21.43	8	2	7.14
Quadrula pustulosa	Pimpleback	2	0.47	22	1.20	16	10	23.81	6	2	7.14
Strophitus undulatus	Squawfoot	0	0.00	0	0.00	2	0	0.00	0	0	0.00
Tritogonia verrucosa	Pistolgrip	1	0.23	18	0.98	13	7	16.67	3	1	3.57
Utterbackia (=Anodonta) imbecillis	Paper pondshell	3	0.70	3	0.16	1	1	2.38	1	1	3.57
Venustaconcha ellipsiformis	Ellipse	11	2.58	74	4.03	20	15	35.71	9	7	25.00
Corbicula fluminea (introduced)	Asiatic clam	A	A	A	A	34	23	54.76	32	22	78.57
Total Number of Species	**26+ clam**	**18**	--	**21**	--	**27**	**21**	--	**21**	**17**	--
Total Number of Specimens		**427**	--	**1835**	--	--	--	--	--	--	--
Total Number of Sites		--	--	--	--	**42**	**42**	--	**28**	**28**	--

[1]Nomenclature follows that of Turgeon et al. (1988) with modifications as suggested by Williams et al. (1992). Nomenclature used by Oesch (1984) is included in parentheses for cross-referencing.
[2]FLW = Fort Leonard Wood
[3]Tentative identification. Species not included in calculations and Total Number of Species.

Table 5. Species of freshwater mussels observed at each study site on Roubidoux Creek, Pulaski Co., MO, between October 1993 and October 1995.

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE												
		RM 01	RM 02	RM 03	RM 04	RM 05	RM 06	RM 07	RM 08	RM 09	RM 10	RM 11	RM 12	RM 13
Actinonaias ligamentina	Mucket										X	X		X
Alasmidonta marginata	Elktoe				1									
Amblema plicata	Threeridge			X			X	X	X		X	X		
Cumberlandia monodonta	Spectaclecase													
Cyclonaias tuberculata	Purple wartyback													
Elliptio dilatata	Spike		X	X		2		1	10	3	55	X		X
Fusconaia flava	Wabash pigtoe		X			1	1		4	1	4		X	X
Fusconaia ozarkensis[2]	Ozark pigtoe								2?[2]					
Lampsilis cardium	Plain pocketbook		X	X		1	X	4	2		X	X	X	X
Lampsilis reeviana	Northern broken-ray	1		3				2	1	4	14		X	X
Lampsilis siliquoidea (=radiata)	Fatmucket	1	X	1		2	5	3	X		4	X	X	X
Pleurobema coccineum	Round pigtoe								X	1	5			X
Potamilus alatus	Pink heelsplitter													
Quadrula metanevra	Monkeyface						1	1			1			
Tritogonia verrucosa	Pistolgrip										X			
Venustaconcha ellipsiformis	Ellipse							11	5			X	X	X
Corbicula fluminea (introduced)	Asiatic clam	X	X					A			X		X	X
Total Number of Species	15 + clam	3	5	5	1	4	5	8	8	5	11	8	6	10

Note: Sites 3–13 are located within the boundaries of FLW. (Numbers represent live specimens found at the site, an "X" represents one or more dead specimens, and an "A" indicates live specimens were found and not counted.)

[1]Nomenclature follows that of Turgeon et al. (1988) with modifications as suggested by Williams et al. (1992). Nomenclature cused by Oesch (1984) is included in parentheses for cross-referencing.

[2]Tentative identification. Tissue needed for positive identification; unfortunately, tissue was not preserved. Species not included in Total Number of Species.

Table 6. Summary of freshwater mussels found in Roubidoux Creek, Pulaski and Texas counties, MO, between October 1993 and October 1995.

		Live Specimens				Site Frequency					
SCIENTIFIC NAME[1]	COMMON NAME[1]	No. Found on FLW[2]	% of FLW Total	Total Number Found	% of All Live	No. of Sites Where Found	No. of Sites Where Found Live	% of All Sites Found w/Live Spec.	# Sites Where Found on FLW	No. of Sites Where Found Liveon FLW	% of Sites Where Found Live on FLW
Actinonaias ligamentina	Mucket	0	0.00	0	0.00	3	0	0.00	3	0	0.00
Alasmidonta marginata	Elktoe	1	0.65	1	0.64	1	1	7.69	1	1	9.09
Amblema plicata	Threeridge	0	0.00	0	0.00	6	0	0.00	6	0	0.00
Cumberlandia monodonta	Spectaclecase	0	0.00	0	0.00	1	0	0.00	1	0	0.00
Cyclonaias tuberculata	Purple wartyback	0	0.00	0	0.00	1	0	0.00	1	0	0.00
Elliptio dilatata	Spike	71	45.81	71	45.22	9	5	38.46	8	5	45.45
Fusconaia flava	Wabash pigtoe	11	7.10	11	7.01	8	5	38.46	7	5	45.45
Fusconaia ozarkensis[3]	Ozark pigtoe	2	--	2	--	1	1	--	1	1	--
Lampsilis cardium	Plain pocketbook	7	4.52	7	4.46	10	3	23.08	9	3	27.27
Lampsilis reeviana	Northern broken-ray	24	15.48	25	15.92	8	6	46.15	7	5	45.45
Lampsilis siliquoidea (=*radiata*)	Fatmucket	15	9.68	16	10.19	11	6	46.15	9	5	45.45
Pleurobema coccineum	Round pigtoe	6	3.87	6	3.82	4	2	15.38	4	2	18.18
Potamilus alatus	Pink heelsplitter	0	0.00	0	0.00	1	0	0.00	1	0	0.00
Quadrula metanevra	Monkeyface	3	1.94	3	1.91	3	3	23.08	3	3	27.27
Tritogonia verrucosa	Pistolgrip	0	0.00	0	0.00	1	0	0.00	1	0	0.00
Venustaconcha ellipsiformis	Ellipse	17	10.97	17	10.83	6	3	23.08	6	3	27.27
Corbicula fluminea (introduced)	Asiatic clam	A	--	A	--	6	1	--	4	1	--
Total Number of Species	15 + clam	10	--	10	--	16	10	--	16	10	--
Total Number of Specimens		155	--	157	--	--	--	--	--	--	--
Total Number of Sites		--	--	--	--	13	13	--	11	11	--

[1]Nomenclature follows that of Turgeon et al. (1988) with modifications as suggested by Williams et al. (1992). Nomenclature used by Oesch (1984) is included in parentheses for cross-referencing.

[2]FLW = Fort Leonard Wood.

[3]Tentative identification. Species not included in calculations and Total Number of Species.

Table 7. Federally and state-listed freshwater mussels found during surveys of FLW, Big Piney River, and Roubidoux Creek in Pulaski, Phelps, and Texas counties, between October 1993 and October 1995.

SCIENTIFIC NAME	COMMON NAME	STATUS FED.	STATE	T	R	S	DATE OBS.	COMMENTS
Alasmidonta marginata	Elktoe	C2	SU	34N	12W	36	08/09/94	Roubidoux Creek; RM 04; one live specimen
Alasmidonta marginata	Elktoe	C2	SU	34N	10W	5	07/21/94	Big Piney River; BPM 02; one live specimen
Alasmidonta marginata	Elktoe	C2	SU	35N	10W	10	12/05/93	Big Piney River; BPM 37; one shell
Cumberlandia monodonta	Spectaclecase	C2	WL	34N	10W	8	12/01/93	Big Piney River; BPM 01; one shell
Cumberlandia monodonta	Spectaclecase	C2	WL	34N	10W	5	12/01/93	Big Piney River; BPM 02; one shell
Cumberlandia monodonta	Spectaclecase	C2	WL	35N	10W	19	11/04/93	Big Piney River; BPM 20; one shell
Cumberlandia monodonta	Spectaclecase	C2	WL	35N	10W	17	11/23/93	Big Piney River; BPM 31; one shell
Cumberlandia monodonta	Spectaclecase	C2	WL	35N	10W	10	12/05/93	Big Piney River at Spring Creek; BPM 37; shell only (10-15)
Cumberlandia monodonta	Spectaclecase	C2	WL	35N	10W	10	02/18/94	Big Piney River, BPM 36; one shell
Cumberlandia monodonta	Spectaclecase	C2	WL	34N	10W	5	07/14/94	Big Piney River; BPM 04; one shell
Cumberlandia monodonta	Spectaclecase	C2	WL	35N	10W	7	08/06/94	Big Piney River; BPM 41; one shell
Cumberlandia monodonta	Spectaclecase	C2	WL	35N	10W	6	10/15/94	Big Piney River; BPM 42; one shell
Cumberlandia monodonta	Spectaclecase	C2	WL	36N	10W	17 18	10/31/94	Big Piney River at Devil's Elbow; 57 live specimens
Cumberlandia monodonta	Spectaclecase	C2	WL	36N	10W	7	09/03/95	Big Piney River north of I-44 bridge; 250 live specimens
Cumberlandia monodonta	Spectaclecase	C2	WL	34N	12W	24	12/04/93	Roubidoux Creek; RM 11; one shell
Ptychobranchus occidentalis	Ouachita kidneyshell	C2	WL	34N	10W	8	12/01/93	Big Piney River; BPM 01; one weathered shell

Note: C2 status is no longer used by USFWS.

Table 8. Fish known to occur in Big Piney River, Roubidoux Creek, and associated tributaries.

Scientific Name[1]	Common Name	Fleener et al. (1974)[2]	Pflieger (1974)[3]	Pflieger (1975)[4]	This Study
Petromyzonidae	Lampreys				
Ichthyomyzon castaneus	Chestnut lamprey	B			
Ichthyomyzon fossor	Northern brook lamprey	B		B	
Lepisosteidae	Gars				
Lepisosteus osseus	Longnose gar	B	B	B	B
Lepisosteus platostomus	Shortnose gar	B			
Hiodontidae	Mooneyes				
Hiodon tergisus (MO: Rare)	Mooneye	B			B
Anguillidae	Eels				
Anguilla rostrata	American eel	B		B	
Clupeidae	Herrings				
Alosa chrysochloris	Skipjack herring	B			
Dorosoma cepedianum	Gizzard shad	B	B	B	B
Cyprinidae	Minnows				
Campostoma anomalum	Central stoneroller	B	B	B,R	B,R,EG,FH, HH,MC
Campostoma oligolepis	Largescale stoneroller	B	B	B,R	B,R,BH,FH, MH,TH
Carassius auratus	Goldfish			B	
Cyprinella spiloptera	Spotfin shiner	B	B	B	B
Cyprinus carpio	Common carp	B		B	B
Erimystax x-punctatus	Gravel chub	B	B	B	B
Luxilus chrysocephalus	Striped shiner			B	B,R,HH
Luxilus zonatus	Bleeding shiner	B	B	B,R	B,R,BH,EG, FH,MH,TH
Lythrurus umbratilis	Redfin shiner	B	B	B,R	B
Nocomis biguttatus	Hornyhead chub	B	B	B,R	B,R,FH
Notemigonus crysoleucas	Golden shiner	B	B	B	
Notropis boops	Bigeye shiner	B	B	B,R	B,R,EG, MH,TH
Notropis greenei	Wedgespot shiner	B	B	B,R	B,R,FH
Notropis heterolepis (MO: Rare)	Blacknose shiner	B	B	B,R	R
Notropis nubilus	Ozark minnow	B	B	B,R	B,R,EG,TH
Notropis rubellus	Rosyface shiner	B	B	B	B,R

Scientific Name[1]	Common Name	Fleener et al. (1974)[2]	Pflieger (1974)[3]	Pflieger (1975)[4]	This Study
Notropis stramineus	Sand shiner				R
Phoxinus erythrogaster	Southern redbelly dace	B	B	B	B,R, BH,EG, FH,HH, MH,TH
Pimephales notatus	Bluntnose minnow	B	B	B,R	B,R
Pimephales promelas	Fathead minnow				BH
Semotilus atromaculatus	Creek chub	B	B	B	B,R, BH,FH, MH,TH
Catostomidae	Suckers				
Carpiodes carpio	River carpsucker	B			
Carpiodes cyprinus	Quillback	B		B	
Carpiodes velifer (MO: Rare)	Highfin carpsucker	B			
Catostomus commersoni	White sucker	B	B	B,R	R
Hypentelium nigricans	Northern hog sucker	B	B	B,R	B,R,TH
Ictiobus bubalus	Smallmouth buffalo	B			
Moxostoma anisurum	Silver redhorse	B	B	B	
Moxostoma carinatum	River redhorse	B		B	
Moxostoma duquesnei	Black redhorse	B	B	B,R	B,R
Moxostoma erythrurum	Golden redhorse	B	B	B,R	B,R
Moxostoma macrolepidotum	Shorthead redhorse	B		B	
Ictaluridae	Catfishes				
Ameiurus melas	Black bullhead	B		B	B,R
Ameiurus natalis	Yellow bullhead	B	B	B,R	B,R
Ictalurus punctatus	Channel catfish	B		B	
Noturus exilis	Slender madtom	B	B	B,R	B,R,EG,FH
Noturus flavus	Stonecat	B		B	B,R
Pylodictis olivaris	Flathead catfish	B		B	B
Salmonidae	Trouts				
Oncorhynchus mykiss	Rainbow trout			B	B
Cyprinodontidae	Killifishes				
Fundulus catenatus	Northern studfish	B	B	B,R	B,R,BH,EG, FH,MH
Fundulus olivaceus	Blackspotted topminnow	B	B	B,R	B,R

Scientific Name[1]	Common Name	Fleener et al. (1974)[2]	Pflieger (1974)[3]	Pflieger (1975)[4]	This Study
Fundulus sciadicus (Federal: Fomerly C2; MO: Status Undetermined)	Plains topminnow	B	B	B	B,FH
Poecilidae	Livebearers				
Gambusia affinis	Mosquitofish				B,FH,HH
Atherinidae	Silversides				
Labidesthes sicculus	Brook silverside	B	B	B,R	B,R
Cottidae	Sculpins				
Cottus carolinae	Banded sculpin	B	B	B	B
Cottus hypselurus	Ozark sculpin	B	B	B,R	B,R,FH
Centrarchidae	Sunfishes				
Ambloplites rupestris	Rock bass	B	B	B,R	B,R
Lepomis cyanellus	Green sunfish	B	B	B,R	B,R,BH, FH,HH, MC
Lepomis humilis	Orangespotted sunfish	B		B	
Lepomis macrochirus	Bluegill	B	B	B,R	B,R,HH
Lepomis megalotis	Longear sunfish	B	B	B,R	B,R,TH
Micropterus dolomieu	Smallmouth bass	B	B	B,R	B,R
Micropterus punctulatus	Spotted bass	B			
Micropterus salmoides	Largemouth bass	B	B	B,R	B,R,HH
Pomoxis annularis	White crappie	B	B	B	B
Pomoxis nigromaculatus	Black crappie	B			B
Percidae	Perches				
Etheostoma blennioides	Greenside darter	B	B	B,R	B,R,MH
Etheostoma caeruleum	Rainbow darter	B	B	B,R	B,R,EG, FH
Etheostoma flabellare	Fantail darter	B		B,R	B,R,BH, EG,FH, MH
Etheostoma punctulatum	Stippled darter			B,R	
Etheostoma spectabile	Orangethroat darter	B	B	B,R	B,R,BH, EG,FH, MH,TH
Etheostoma tetrazonum	Missouri saddled darter	B	B	B	B,R
Etheostoma zonale	Banded darter	B	B	B	B,R
Percina caprodes	Logperch	B	B	B,R	B,R

Scientific Name[1]	Common Name	Fleener et al. (1974)[2]	Pflieger (1974)[3]	Pflieger (1975)[4]	This Study
Percina cymatotaenia (Federal: Formerly C2; MO: Rare)	Bluestripe darter	B	B	B,R	B
Percina evides	Gilt darter	B	B	B	B
Percina phoxocephala	Slenderhead darter	B		B	R
Stizostedion vitreum	Walleye	B		B	
Sciaendae	Drums				
Aplodinotus grunniens	Freshwater drum	B		B	B
Total Number of Species	Big Piney River: 75 Roubidoux Creek: 43 Both Streams: 77	B: 70 R: 0	B: 36 R: 0	B: 65 R: 33 Both: 65	B: 53 R: 40 BH: 9 EG: 10 FH: 16 HH: 7 MC: 2 MH: 9 TH: 9 All: 57

Note: B = Big Piney River; R = Roubidoux Creek; BH = Ballard Hollow; EG = East Gate Tributary; FH - Falls Hollow; HH = Hurd Hollow; MC = McCann Hollow; MH = Musgrave Hollow; TH = Turnbull Hollow. Sampling for this study occurred between April 1994 and October 1995.

[1]Nomenclature follows Robins et al. (1991).

[2]1951-1958 survey of Big Piney River.

[3]1963-1975 survey of Big Piney River.

[4]Statewide collections, pre-1905 to 1975.

Table 9A. Results of fish sampling on stretches of Big Piney River, Pulaski Co., MO, between April 1994 and October 1995.

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE										
		BPF 01	BPF 02	BPF 03	BPF 04	BPF 05	BPF 06	BPF 07	BPF 08	BPF 09	BPF 10	BPF 11
Lepisosteus osseus	Longnose gar			1			1					
Dorosoma cepedianum	Gizzard shad											
Cyprinus carpio	Common carp											
Semotilus atromaculatus	Creek chub											
Phoxinus erythrogaster	Southern redbelly dace											
Nocomis biguttatus	Hornyhead chub						2	8	44			
Erimystax x-punctatus	Gravel chub			1				5			6	
Notropis rubellus	Rosyface shiner	26		15		27	3					
Lythrurus umbratilis	Redfin shiner											
Luxilus zonatus	Bleeding shiner	82	172	134	3	47	158	57	68	74	136	10
Luxilus chrysocephalus	Striped shiner	6						8	53	95		
Cyprinella spiloptera	Spotfin shiner											
Notropis boops	Bigeye shiner			1								
Notropis greenei	Wedgespot shiner	1	28	40	45	5	22					
Notropis nubilus	Ozark minnow	1			2	1	1	112	41	1		
Pimephales notatus	Bluntnose minnow							56	6	2		
Campostoma oligolepis	Largescale stoneroller	1	6	1		3	3	20	4	5	1	
Campostoma anomalum	Central stoneroller				1	17						
Hypentelium nigricans	Northern hog sucker											
Moxostoma duquesnei	Black redhorse							4				

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE										
		BPF 01	BPF 02	BPF 03	BPF 04	BPF 05	BPF 06	BPF 07	BPF 08	BPF 09	BPF 10	BPF 11
Moxostoma erythrurum	Golden redhorse											
Moxostoma sp.	Redhorse sp.				2							
Ameiurus melas	Black bullhead											
Ameiurus natalis	Yellow bullhead											
Noturus exilis	Slender madtom		1				1				2	
Noturus flavus	Stonecat						1				1	
Pylodictis olivaris	Flathead catfish											
Fundulus catenatus	Northern studfish		10+	60		15	2	8	1		2	2
Fundulus olivaceus	Blackspotted topminnow											
*Fundulus sciadicus**	Plains topminnow							1				
Gambusia affinis	Mosquitofish			6				5				
Labidesthes sicculus	Brook silverside							1				
Aplodinotus grunniens	Freshwater drum											
Cottus hypselurus	Ozark sculpin	2	2			4	3		1		3	2
Cottus carolinae	Banded sculpin	2	2	2		4	1		2	2	6	
Micropterus dolomieu	Smallmouth bass			1			2		4	4	18	
Micropterus salmoides	Largemouth bass			1					1			
Lepomis cyanellus	Green sunfish								4			
Lepomis macrochirus	Bluegill											
Lepomis megalotis	Longear sunfish			4			1	1				
Lepomis sp.	Hybrid sunfish											

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE										
		BPF 01	BPF 02	BPF 03	BPF 04	BPF 05	BPF 06	BPF 07	BPF 08	BPF 09	BPF 10	BPF 11
Ambloplites rupestris	Rock bass								55	30	5	
Pomoxis nigromaculatus	Black crappie											
Pomoxis annularis	White crappie											
Percina caprodes	Logperch		1					1				
*Percina cymatotaenia***	Bluestripe darter											
Percina evides	Gilt darter											
Etheostoma tetrazonum	Missouri saddled darter	2				1						1
Etheostoma zonale	Banded darter								1	2	1	
Etheostoma blennioides	Greenside darter			1			2	2	2	7	3	
Etheostoma caeruleum	Rainbow darter	24	3			17	5		6	1	13	5
Etheostoma spectabile	Orangethroat darter	11				1	1		12		1	1
Etheostoma flabellare	Fantail darter											
Total Number of Species - 51		11	9	14	5	12	17	15	17	11	14	6

Note: Sites 7 to 31 are located either within FLW or directly adjacent to FLW.
* Missouri: Status Undetermined; Federal: formerly C2
**Missouri: Rare; Federal: formerly C2
[1]Nomenclature follows Robins et al. (1991).

Table 9B. Results of fish sampling on stretches of Big Piney River, Pulaski Co., MO, between April 1994 and October 1995.

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE										
		BPF 12	BPF 13	BPF 14	BPF 15	BPF 16	BPF 17	BPF 18	BPF 19	BPF 20	BPF 21	BPF 22
Lepisosteus osseus	Longnose gar								1			
Dorosoma cepedianum	Gizzard shad					4						
Cyprinus carpio	Common carp						5					
Semotilus atromaculatus	Creek chub				1							
Phoxinus erythrogaster	Southern redbelly dace				1	8						
Nocomis biguttatus	Hornyhead chub	24	12	4	2		6		1	26		18
Erimystax x-punctatus	Gravel chub			2					2			
Notropis rubellus	Rosyface shiner			7	1			6				1
Lythrurus umbratilis	Redfin shiner											
Luxilus zonatus	Bleeding shiner	49	33	2	95	16	5+	68	31	12	13	51
Luxilus chrysocephalus	Striped shiner	64	73		1	9		6				20
Cyprinella spiloptera	Spotfin shiner											
Notropis boops	Bigeye shiner		2		10							
Notropis greenei	Wedgespot shiner			71	3						1	
Notropis nubilus	Ozark minnow	3	23	4				1				
Pimephales notatus	Bluntnose minnow	2	4		5		2	1	1			2
Campostoma oligolepis	Largescale stoneroller		11	8	10	16	8	3	3			37
Campostoma anomalum	Central stoneroller			17			5					
Hypentelium nigricans	Northern hog sucker						4					
Moxostoma duquesnei	Black redhorse					2	3					1
Moxostoma erythrurum	Golden redhorse					11	14		1			
Moxostoma sp.	Redhorse sp.											

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE										
		BPF 12	BPF 13	BPF 14	BPF 15	BPF 16	BPF 17	BPF 18	BPF 19	BPF 20	BPF 21	BPF 22
Ameiurus melas	Black bullhead											
Ameiurus natalis	Yellow bullhead	25	1									
Noturus exilis	Slender madtom			1								
Noturus flavus	Stonecat											
Pylodictis olivaris	Flathead catfish					1						
Fundulus catenatus	Northern studfish	17	34	15	24				1		1	
Fundulus olivaceus	Blackspotted topminnow	1	2									
*Fundulus sciadicus**	Plains topminnow											
Gambusia affinis	Mosquitofish	31	8		1				1			
Labidesthes sicculus	Brook silverside				3			5				
Aplodinotus grunniens	Freshwater drum											
Cottus hypselurus	Ozark sculpin			6			1		1			
Cottus carolinae	Banded sculpin		2	1	1				1	1	1	
Micropterus dolomieu	Smallmouth bass	7					12		5	1	1	
Micropterus salmoides	Largemouth bass		3			2	4	1				2
Lepomis cyanellus	Green sunfish						3		1			
Lepomis macrochirus	Bluegill	1	13			2	11					
Lepomis megalotis	Longear sunfish	1	1		2		18		6			
Lepomis sp.	Hybrid sunfish						2					
Ambloplites rupestris	Rock bass		16			2	11			1		
Pomoxis nigromaculatus	Black crappie					1	2					
Pomoxis annularis	White crappie					1						

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE										
		BPF 12	BPF 13	BPF 14	BPF 15	BPF 16	BPF 17	BPF 18	BPF 19	BPF 20	BPF 21	BPF 22
Percina caprodes	Logperch						3					
*Percina cymatotaenia***	Bluestripe darter		1			1						
Percina evides	Gilt darter											
Etheostoma tetrazonum	Missouri saddled darter			1								
Etheostoma zonale	Banded darter		1									
Etheostoma blennioides	Greenside darter				1		1		6	1	1	
Etheostoma caeruleum	Rainbow darter											
Etheostoma spectabile	Orangethroat darter		5	10					7	7		
Etheostoma flabellare	Fantail darter											
Total Number of Species - 51		12	20	15	16	14	20	8	16	7	6	8

Note: Sites 7 to 31 are located either within FLW or directly adjacent to FLW.
*Missouri: Status Undetermined; Federal: formerly C2
**Missouri: Rare; Federal: formerly C2
[1]Nomenclature follows Robins et al. (1991).

Table 9C. Results of fish sampling on stretches of Big Piney River, Pulaski Co., MO, between April 1994 and October 1995.

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE								
		BPF 23	BPF 24	BPF 25	BPF 26	BPF 27	BPF 28	BPF 29	BPF 30	BPF 31
Lepisosteus osseus	Longnose gar	1		5			1	20	5	
Dorosoma cepedianum	Gizzard shad							1		
Cyprinus carpio	Common carp						1	20+		
Semotilus atromaculatus	Creek chub									
Phoxinus erythrogaster	Southern redbelly dace									
Nocomis biguttatus	Hornyhead chub	4	5	6		5		1	6	
Erimystax x-punctatus	Gravel chub					5	1			
Notropis rubellus	Rosyface shiner				1	1	10		6	16
Lythrurus umbratilis	Redfin shiner					160				
Luxilus zonatus	Bleeding shiner		34	67	13	1	107	57	259	28
Luxilus chrysocephalus	Striped shiner			3	10		4	4	13	
Cyprinella spiloptera	Spotfin shiner						14			2
Notropis boops	Bigeye shiner						3			2
Notropis greenei	Wedgespot shiner									37
Notropis nubilus	Ozark minnow				34	120	1	5		3
Pimephales notatus	Bluntnose minnow					2	9	60	1	
Campostoma oligolepis	Largescale stoneroller		3	63	5	22	2	1	3	19
Campostoma anomalum	Central stoneroller									
Hypentelium nigricans	Northern hog sucker									
Moxostoma duquesnei	Black redhorse				1	4		3		
Moxostoma erythrurum	Goldern redhorse							1		
Moxostoma sp.	Redhorse sp.									

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE								
		BPF 23	BPF 24	BPF 25	BPF 26	BPF 27	BPF 28	BPF 29	BPF 30	BPF 31
Ameiurus melas	Black bullhead					1				
Ameiurus natlis	Yellow bullhead						1	1	1	
Noturus exilis	Slender madtom									
Noturus flavus	Stonecat									
Pylodictis olivaris	Flathead catfish									
Fundulus catenatus	Northern studfish				3		50		8+	
Fundulus olivaceus	Blackspotted topminnow									
*Fundulus sciadicus**	Plains topminnow									
Gambusia affinis	Mosquitofish						1			2
Labidesthes sicculus	Brook silverside						8	2	3	
Aplodinotus grunniens	Freshwater drum							2		
Cottus hypselurus	Ozark sculpin						1		4	
Cottus carolinae	Banded sculpin		2			1	2		3	
Micropterus dolomieu	Smallmouth bass		2	3	2	2	1			1
Micropterus salmoides	Largemouth bass	1		15						
Lepomis cyanellus	Green sunfish									
Lepomis macrochirus	Bluegill							6		
Lepomis megalotis	Longear sunfish	1	1		1	2	8	13	2	
Lepomis sp.	Hybrid sunfish									
Ambloplites rupestris	Rock bass		4	4	2				1	
Pomoxis nigromaculatus	Black crappie							1		
Pomoxis annularis	White crappie							1		

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE								
		BPF 23	BPF 24	BPF 25	BPF 26	BPF 27	BPF 28	BPF 29	BPF 30	BPF 31
Percina caprodes	Logperch		3			1			1	
*Percina cymatotaenia***	Bluestripe darter						1			
Percina evides	Gilt darter		2				1			1
Etheostoma tetrazonum	Missouri saddled darter		1				11		6	
Etheostoma zonale	Banded darter		12			2				
Etheostoma blennioides	Greenside darter	2	5			5	1		2	
Etheostoma caeruleum	Rainbow darter		8				4		7	
Etheostoma spectabile	Orangethroat darter		2			1	4			
Etheostoma flabellare	Fantail darter		1							
Total Number of Species - 51		5	15	8	10	17	25	18	18	10

Note: Sites 7 to 31 are located either within FLW or directly adjacent to FLW.
*Missouri: Status Undetermined; Federal: formerly C2
**Missouri: Rare; Federal: formerly C2
[1]Nomenclature follows Robins et al. (1991).

Table 10A. Results of fish sampling on stretches of Roubidoux Creek, Pulaski Co., MO, within FLW, between April 1994 and October 1995.

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE												
		RF01	RF02	RF03	RF04	RF05	RF06	RF07	RF08	RF09	RF10	RF11A	RF11B	RF11C
Semotilus atromaculatus	Creek chub													
Phoxinus erythrogaster	Southern redbelly dace												4	
Nocomis biguttatus	Hornyhead chub	2	1	11	4	9	10	5		5		1	1	21
Notropis rubellus	Rosyface shiner	1												
Luxilus zonatus	Bleeding shiner	120	55	44	8		121	28	25	227	122	29	29	1
Luxilus chrysocephalus	Striped shiner	6		2		3				4	6		15	
Notropis boops	Bigeye shiner	1		57	12	6	30	6	5	12		5	74	22
Notropis greenei	Wedgespot shiner	2			6		3	3	5	10	15	5		
*Notropis heterolepis**	Blacknose shiner													
Notropis stramineus	Sand shiner				4								2	
Notropis nubilus	Ozark minnow			1			155			9		6		
Pimephales notatus	Bluntnose minnow	5		9	14	29	2			1	3	2	23	
Campostoma oligolepis	Largescale stoneroller	31		1	9	4	13	1		7				
Campostoma anomalum	Central stoneroller	1								5				23
Cyprinidae sp.	Unknown minnow		50											
Catostomus commersoni	White sucker													
Hypentelium nigricans	Northern hog sucker						1			10		2		19
Moxostoma duquesnei	Black redhorse													
Moxostoma erythrurum	Golden redhorse												1	
Ameiurus melas	Black bullhead													
Ameiurus natalis	Yellow bullhead													
Noturus exilis	Slender madtom										1			

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE												
		RF01	RF02	RF03	RF04	RF05	RF06	RF07	RF08	RF09	RF10	RF11A	RF11B	RF11C
Noturus flavus	Stonecat		1											
Fundulus catenatus	Northern studfish	2	30		12		1		2	7	11	3		71
Fundulus olivaceus	Blackspotted topminnow			1										
Labidesthes sicculus	Brook silverside				2					1		2	33	4
Cottus hypselurus	Ozark sculpin	1												
Micropterus dolomieu	Smallmouth bass		4		1	1	1	1			3			5
Micropterus salmoides	Largemouth bass				3	1								
Lepomis cyanellus	Green sunfish						1				1			
Lepomis macrochirus	Bluegill					9						1		
Lepomis megalotis	Longear sunfish		16	18	35	42	16	15	2	4	3			47
Ambloplites rupestris	Rock bass		1	2										
Percina caprodes	Logperch		1											
Percina phoxocephla	Slenderhead darter									2				
Etheostoma tetrazonum	Missouri saddled darter	4						2		10	2			
Etheostoma zonale	Banded darter									2				
Etheostoma blennioides	Greenside darter	3				1		3		2	2			
Etheostoma caeruleum	Rainbow darter	19	2					9		14	8			
Etheostoma spectabile	Orangethroat darter	1				5		1		6	2			
Etheostoma flabellare	Fantail darter									1	1			
Total Number of Species - 40		15	10	10	12	11	12	11	5	20	14	10	9	9

*Missouri: Rare

[1]Nomenclature follows Robins et al. (1991).

Table 10B. Results of fish sampling on stretches of Roubidoux Creek, Pulaski Co., MO, within FLW, between April 1994 and October 1995.

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE											
		RF12	RF13	RF14	RF15	RF16	RF17	RF18	RF19	RF20A	RF20B	RF21	RF22
Semotilus atromaculatus	Creek chub					1							
Phoxinus erythrogaster	Southern redbelly dace												
Nocomis biguttatus	Hornyhead chub		20			37				1			
Notropis rubellus	Rosyface shiner												
Luxilus zonatus	Bleeding shiner	65	195		30	100	39	10	3	32	19	2	16
Luxilus chrysocephalus	Striped shiner	10	1			111			1	2			
Notropis boops	Bigeye shiner	8	22			16	11	1	30	6	7	1	2
Notropis greenei	Wedgespot shiner	7	18					1		80			
*Notropis heterolepis**	Blacknose shiner							1					
Notropis stramineus	Sand shiner						1		2				
Notropis nubilus	Ozark minnow		1			9	3	1	1			1	15
Pimephales notatus	Bluntnose minnow					13	5	2	40	4		2	
Campostoma oligolepis	Largescale stoneroller		5		8	10	2		1	17			3
Campostoma anomalum	Central stoneroller					2						44	
Cyprinidae sp.	Unknown minnow								16				
Catostomus commersoni	White sucker											1	
Hypentelium nigricans	Northern hog sucker		1			35				2			
Moxostoma duquesnei	Black redhorse		1			7	2						
Moxostoma erythrurum	Golden redhorse					4							
Ameiurus melas	Black bullhead					500		4					
Ameiurus natalis	Yellow bullhead		1			10		2				1	
Noturus exilis	Slender madtom			1						1			

SCIENTIFIC NAME[1]	COMMON NAME[1]	SITE											
		RF12	RF13	RF14	RF15	RF16	RF17	RF18	RF19	RF20A	RF20B	RF21	RF22
Noturus flavus	Stonecat												
Fundulus catenatus	Northern studfish	1	15		20	80	72		3	20	1	43	1
Fundulus olivaceus	Blackspotted topminnow						12						
Labidesthes sicculus	Brook silverside					4	13		20	1	7		
Cottus hypselurus	Ozark sculpin									1			
Micropterus dolomieu	Smallmouth bass				1	5					1	2	
Micropterus salmoides	Largemouth bass								1			2	
Lepomis cyanellus	Green sunfish						5	25			1	3	
Lepomis macrochirus	Bluegill							8	5			4	
Lepomis megalotis	Longear sunfish		5	4		22	51	4	7			6	
Ambloplite rupestris	Rock bass												
Percina caprodes	Logperch		3	2				1		1		1	
Percina phoxocephla	Slenderhead darter												
Etheostoma tetrazonum	Missouri saddled darter				1	1							
Etheostoma zonale	Banded darter												
Etheostoma blennioides	Greenside darter		1	1		2				5			
Etheostoma caeruleum	Rainbow darter			1	10	24				13		1	1
Etheostoma spectabile	Orangethroat darter		1			1				6		7	1
Etheostoma flabellare	Fantail darter									1			
Total Number of Species - 40		5	15	5	6	22	12	12	13	17	6	16	7

*Missouri: Rare

[1]Nomenclature follows Robins et al. (1991).

Table 11. Results of fish sampling on selected tributaries of Big Piney River and Roubidoux Creek located within FLW, Pulaski Co., MO, between April 1994 and October 1995.

						SITE				
SCIENTIFIC NAME[1]	**COMMON NAME[1]**	**BH**	**EG**	**FH1**	**FH2**	**HH1**	**HH2**	**MC**	**MH**	**TH**
Semotilus atromaculatus	Creek chub	3		1	3				7	7
Phoxinus erythrogaster	Southern redbelly dace	23	2	3	188	3			25	5
Nocomis biguttatus	Hornyhead chub				9					
Luxilus zonatus	Bleeding shiner	1	4		10				1	4
Luxilus chrysocephalus	Striped shiner					1				
Notropis boops	Bigeye shiner		2						2	3
Notropis greenei	Wedgespot shiner				3					
Notropis nubilus	Ozark minnow		5							4
Pimephales promelas	Fathead minnow	1								
Campostoma oligolepis	Largescale stoneroller	18			12				10	3
Campostoma anomalum	Central stoneroller		1	1	12	10		1		
Hypentelium nigricans	Northern hog sucker									1
Noturus exilis	Slender madtom		1		2					
Fundulus catenatus	Northern studfish	35	7		1				1	
*Fundulus sciadicus**	Plains topminnow				1					
Gambusia affinis	Mosquitofish				1		27			
Cottus hypselurus	Ozark sculpin			1	3					
Micropterus salmoides	Largemouth bass						30			
Lepomis cyanellus	Green sunfish	2			45		33	1		
Lepomis macrochirus	Bluegill						36			
Lepomis megalotis	Longear sunfish									1
Etheostoma blennioides	Greenside darter								1	
Etheostoma caeruleum	Rainbow darter		5	1						
Etheostoma spectabile	Orangethroat darter	23	10		41				4	2
Etheostoma flabellare	Fantail darter	1	2		20				2	
Total Number of Species		9	10	5	14	3	4	2	9	9

*Missouri: Rare

[1]Nomenclature follows Robins et al. (1991).

BH=Ballard Hollow, EG=East Gate Tributary, FH1=Falls Hollow 1, FH2=Falls Hollow 2, HH1=Hurd Hollow 1, HH2=Hurd Hollow 2, MC=McCann Hollow, MH=Musgrave Hollow, TH=Turnbull Hollow.

Table 12. Federally and state-listed fish found on FLW, Pulaski Co., between October 1993 and October 1995.

SCIENTIFIC NAME	COMMON NAME	STATUS FED.	STATUS STATE	T	R	S	DATE OBS.	COMMENTS
Fundulus sciadicus	Plains topminnow	C2	Status Und.	34N	10W	6	07/28/94	Big Piney R.; BPF 07, one fish-just off of FLW
Fundulus sciadicus	Plains topminnow	C2	Status Und.	34N	11W	23	05/30/95	Falls Hollow trib.; Falls Hollow 2; one fish
Hiodon tergisus	Mooneye	--	Rare	35N	10W	29	06/12/95	Big Piney River; near Happy Hollow Bridge; one fish caught by fisherman
Notropis heterolepis	Blacknose shiner	--	Rare	35N	11W	7	08/23/94	Roubidoux Creek; RF 18; one fish
Percina cymatotaenia	Bluestripe darter	C2	Rare	35N	10W	17	08/18/94	Big Piney River; BPF 28; one fish
Percina cymatotaenia	Bluestripe darter	C2	Rare	35N	10W	30	08/22/94	Big Piney River; BPF 16; one fish
Percina cymatotaenia	Bluestripe darter	C2	Rare	35N	10W	33	08/24/94	Big Piney River; BPF 13; one fish (on FLW boundary)
Percina cymatotaenia	Bluestripe darter	C2	Rare	34N	10W	5	09/16/94	Big Piney River; approx. 1/3 mile from FLW; one fish
Percina cymatotaenia	Bluestripe darter	C2	Rare	35N	10W	32	09/16/94	Big Piney River; near quarry slough; one fish
Percina cymatotaenia	Bluestripe darter	C2	Rare	35N	10W	17	09/29/94	Big Piney River; near BPF 28; three fish

Note: C2 status is no longer used by the USFWS.

Table 13. Amphibian and reptile species found at FLW, Pulaski Co., MO, in 1995 and prior records from Pulaski Co.

SCIENTIFIC NAME[1]	COMMON NAME	Johnson[2]	This Survey
AMPHIBIANS			
Cryptobranchidae	**Giant salamanders**		
Cryptobranchus alleganiensis alleganiensis (Fed.: formerly C2; MO: Watch List)	Eastern hellbender	X	
Necturus maculosus	Mudpuppy	X	
Ambystomatidae	**Mole salamanders**		
Ambystoma annulatum (MO: Watch List)	Ringed salamander	X	X
Ambystoma maculatum	Spotted salamander	X	X
*Ambystoma opacum**	Marbled salamander	R	X
*Ambystoma tigrinum tigrinum**	Eastern tiger salamander	R	X
Salamandridae	**Newts**		
Notophthalamus viridescens louisianensis	Central newt	X	X
Plethodontidae	**Lungless salamanders**		
Eurycea longicauda melanopleura	Dark-sided salamander	X	X
Eurycea lucifuga	Cave salamander	X	X
Eurycea multiplicata griseogaster	Graybelly salamander	X	
Hemidactylium scutatum (MO: Rare)	Four-toed salamander	R	
Plethodon albagula	Western slimy salamander	X	X
Plethodon serratus	Southern redback salamander	X	X
Typhlotriton spelaeus (MO: Watch List)	Grotto salamander	X	X
Bufonidae	**Toads**		
Bufo americanus charlesmithi	Dwarf American toad	X	X
Bufo woodhousii fowleri	Fowler's toad	X	X
Hylidae	**Treefrogs and their allies**		
Acris crepitans blanchardi	Blanchard's cricket frog	X	X
Hyla versicolor	Eastern gray treefrog	X	X
Hyla crucifer crucifer	Northen spring peeper	O	X
Pseudacris triseriata triseriata	Western chorus frog	X	X
Microhylidae	**Narrowmouth toads**		
Gastrophryne carolinensis	Eastern narrowmouth toad	X	X
Ranidae	**True frogs**		
Rana catesbeiana	Bull frog	X	X
Rana clamitans melanota	Green frog	X	X
Rana palustris	Pickerel frog	X	X
Rana utricularia	Southern leopard frog	X	X
REPTILES			
Chelydridae	**Snapping turtles**		
Chelydra serpentina serpentina	Common snapping turtle	O	X
Kinosternidae	**Musk and mud turtles**		
Sternotherus odoratus	Common musk turtle	O	X

SCIENTIFIC NAME[1]	COMMON NAME	Johnson[2]	This Survey
Emydidae	**Box and water turtles**		
Chrysemys picta bellii	Western painted turtle	O	
Graptemys geographica	Common map turtle	X	X
Graptemys p. pseudogeographica	False map turtle	R	
Pseudemys concinna metteri	Missouri River cooter	X	
Terrapene carolina triunguis	Three-toed box turtle	X	X
Terrapene ornata ornata	Ornate box turtle	R	
*Trachemys scripta elegans***	Red-eared slider	O	X
Trionychidae	**Softshell turtles**		
Apalone muticus muticus	Midland smooth softshell	X	X
Apalone spinifera hartwegi	Western spiny softshell	X	X
Iguanidae	**Iguanid lizards**		
Crotaphytus collaris collaris (MO: Watch List)	Eastern collared lizard	R	
Phrynosomatidae	**Earless, spiny, tree, side-blotched, and horned lizards**		
Sceloporus undulatus hyacinthinus	Northern fence lizard	X	X
Teiidae	**Whiptails**		
Cnemidophorus sexlineatus viridis	Prairie racerunner	X	X
Anguidae	**Glass lizards and others**		
Ophisaurus attenuatus attenuatus	Western slender glass lizard	R	
Scincidae	**Skinks**		
Eumeces anthracinus pluvialis	Southern coal skink	X	X
Eumeces fasciatus	Five-lined skink	X	X
*Eumeces laticeps**	Broadhead skink		X
Scincella lateralis	Ground skink	X	X
Colubridae	**Colubrids**		
Carphophis vermis	Western worm snake	X	X
Cemophora coccinea copei (MO: Rare)	Northern scarlet snake	R	
Coluber constrictor flaviventris	Eastern yellowbelly racer	X	X
Diadophis punctatus arnyi	Prairie ringneck snake	X	X
Elaphe guttata emoryi	Great Plains rat snake	X	
Elaphe obsoleta obsoleta	Black rat snake	X	X
*Heterodon platirhinos**	Eastern hognose snake	R	X
*Lampropeltis calligaster calligaster**	Prairie kingsnake	R	X
Lampropeltis getula holbrooki	Speckled kingsnake	X	X
Lampropeltis triangulum syspila	Red milk snake	X	X
Masticophis flagellum flagellum	Eastern coachwhip	X	
Nerodia sipedon sipedon	Northern water snake	X	X
*Opheodrys aestivus***	Rough green snake	O	X
Pituophis melanoleucus sayi	Bullsnake	R	
Storeria dekayi wrightorum	Midland brown snake	X	X
Storeria occipitomaculata occipitomaculata	Northern redbelly snake	X	X
Tantilla gracilis	Flathead snake	X	X
Thamnophis proximus proximus	Western ribbon snake	X	X

SCIENTIFIC NAME[1]	COMMON NAME	Johnson[2]	This Survey
Thamnophis sirtalis sirtalis	Eastern garter snake	X	X
Virginia striatula	Rough earth snake	R	
*Virginia valeriae elegans**	Western earth snake	R	X
Viperidae	**Vipers**		
Agkistrodon contortrix phaeogaster	Osage copperhead	X	X
Agkistrodon piscivorus leucostoma	Western cottonmouth	X	
Crotalus horridus	Timber rattlesnake	R	

Source: Johnson (unpublished).
*New record for Pulaski County.
**Updated record for Pulaski County.
[1]Nomenclature follows Conant and Collins (1991).
[2]Prior records are from T. Johnson's (MDC) amphibian and reptile database for Missouri.

Table 14. Federally and state-listed amphibians and reptiles found during surveys of FLW, Pulaski Co., between March and October 1995.

SCIENTIFIC NAME	COMMON NAME	STATUS FED.	STATUS STATE	T	R	S	DATE OBS.	COMMENTS
Ambystoma annulatum	Ringed salamander	--	Watch List	35N	11W	20	05/25/95	LCTA #47 and #316; one juvenile at each site
Ambystoma annulatum	Ringed salamander	--	Watch List	34N	12W	01	05/25/95	LCTA #324; one juvenile
Ambystoma annulatum	Ringed salamander	--	Watch List	34N	11W	04	09/19/95	Range 12 foxholes; one adult and one juvenile
Typhlotriton spelaeus	Grotto salamander	--	Watch List	34N	12W	11	06/28/95	Cave; two larvae
Typhlotriton spelaeus	Grotto salamander	--	Watch List	34N	12W	25	09/21/95	Cave; two adults and five larvae

Table 15. Amphibian and reptile species found by survey method at FLW, Pulaski Co., MO, in 1995.

		SURVEY METHODS[1,2]									
SCIENTIFIC NAME	**COMMON NAME**	**SHS**	**RC**	**F&T**	**TFT**	**AFT**	**TTS**	**ATS**	**IO**	**C**	**TOTAL #**
AMPHIBIANS											
Ambystoma annulatum	Ringed salamander				3				2		5
Ambystoma maculatum	Spotted salamander		5					1	2		8
Ambystoma opacum	Marbled salamander		13		1				7		21
Ambystoma tigrinum tigrinum	Eastern tiger salamander								1		1
Notophthalamus viridescens louisianensis	Central newt				3				1		4
Eurycea longicauda melanopleura	Dark-sided salamander									3	3
Eurycea lucifuga	Cave salamander									5	5
Plethodon albagula	Western slimy salamander				8		3		1	1	13
Plethodon serratus	Southern redback salamander				13		1				14
Typhlotriton spelaeus	Grotto salamander	9									9
Bufo americanus charlesmithi	Dwarf American toad		38	15	4		5	1	30		93
Bufo woodhousei fowleri	Fowler's toad		1								1
Acris crepitans blanchardi	Blanchard's cricket frog		1	39					1		41
Hyla crucifer crucifer	Northen spring peeper		10	47	2		1	2	4		66
Hyla versicolor	Gray treefrog		9	64			1	2	1		77
Pseudacris triseriata triseriata	Western chorus frog			4					2		6
Gastrophryne carolinensis	Eastern narrowmouth toad						6				6
Rana catesbeiana	Bullfrog		1	15							16
Rana clamitans melanota	Green frog		2	36			1		5		44

		SURVEY METHODS[1,2]									
SCIENTIFIC NAME	**COMMON NAME**	**SHS**	**RC**	**F&T**	**TFT**	**AFT**	**TTS**	**ATS**	**IO**	**C**	**TOTAL #**
AMPHIBIANS											
Rana palustris	Pickerel frog		1	1			6		7	2	17
Rana utricularia	Southern leopard frog		2	19				1	1		23
REPTILES											
Chelydra serpentina serpentina	Common snapping turtle					7					7
Sternotherus odoratus	Common musk turtle					34			1		35
Graptemys geographica	Common map turle								2		2
Terrapene carolina triunguis	Three-toed box turtle						1		37		38
Trachemys scripta elegans	Red-eared slider					62			11		73
Apalone muticus muticus	Midland smooth softshell								1		1
Apalone spinifer spinifer	Eastern spiny softshell								1		1
Sceloporus undulatus hyacinthinus	Northern fence lizard				2		7		18		27
Eumeces anthracinus pluvialis	Southern coal skink						1				1
Eumeces fasciatus	Five-lined skink				6		3		2		11
Eumeces laticeps	Broadhead skink				7		7		1		15
Scincella lateralis	Ground skink				44		5		8		57
Cnemidophorus sexlineatus viridis	Prairie racerunner						4		3		7
Carphophis vermis	Western worm snake				1		2				3
Coluber constrictor flaviventris	Eastern yellowbelly snake						1		2		3
Diadophis punctatus arnyi	Prairie ringneck snake						2				2

		SURVEY METHODS[1,2]									
SCIENTIFIC NAME	**COMMON NAME**	**SHS**	**RC**	**F&T**	**TFT**	**AFT**	**TTS**	**ATS**	**IO**	**C**	**TOTAL #**
REPTILES											
Elaphe obsoleta obsoleta	Black rat snake								5		5
Heterodon platirhinos	Eastern hognose snake						1		3		4
Lampropeltis calligaster calligaster	Prairie kingsnake								1		1
Lampropeltis getula holbrooki	Speckled kingsnake								1		1
Lampropeltis triangulum syspila	Red milk snake						1		1		2
Nerodia sipedon sipedon	Northern water snake				1				4		5
Opheodrys aestivus	Rough green snake								2		2
Storeria dekayi wrightorum	Midland brown snake						1				1
Storeria occipitomaculata occipitomaculata	Northern redbelly snake				5		1				6
Tantilla gracilis	Flathead snake						5		1		6
Thamnophis proximus proximus	Western ribbon snake								1		1
Thamnophis sirtalis sirtalis	Eastern garter snake						1		5		6
Virginia valeriae elegans	Western earth snake				5		1				6
Agkistrodon contortrix phaeogaster	Osage copperhead		1				2			1	4
TOTALS		9	84	240	105	103	70	7	176	12	708

[1]Survey Methods:
SHS = Special Habitat Search
RC = Road Cruise
F&T = Frog and Toad Breeding Call Survey
TFT = Terrestrial Funnel Trapping
AFT = Aquatic Funnel Trapping
TTS = Terrestrial Time Search
ATS = Aquatic Time Search
IO = Incidental Observation
C = Caving

[2]Number of individuals captured.

Table 16. Bird species reported from FLW, Pulaski Co., MO, with conservation status and neotropical migrant status indicated for each species.

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Gaviidae	**Loons**										
Gavia immer	Common loon		X								
Podicipedidae	**Grebes**										
Podiceps auritus	Horned grebe		X								
Podilymbus podiceps[R]	Pied-billed grebe	X	X								X
Phalacrocoracidae	**Cormorants**										
Phalacrocorax auritus	Double-crested cormorant	X	X								X
Ardeidae	**Bitterns and herons**										
Ardea albus[R]	Great egret	X									X
Ardea herodias	Great blue heron	X	X			X1	X4				X
Bubulcus ibis	Cattle egret	X	X								
Butorides virescens	Green heron	X	X	PO	X1						X
Egretta thula[E]	Snowy egret	X	X								
Nyctanessa violaceus	Yellow-crowned night-heron	X	X								X
Anatidae	**Swans, geese and ducks**										
Aix sponsa	Wood duck	X	X	PO			X1				X
Anas acuta	Northern pintail	X	X								
Anas americana	American wigeon	X	X								
Anas clypeata	Northern shoveler	X	X								
Anas crecca	Green-winged teal	X	X								
Anas discors	Blue-winged teal	X	X								X

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Anas platyrhynchos	Mallard	X	X								
Anas strepera	Gadwall	X	X								
Aythya affinis	Lesser scaup	X	X								X
Aythya americana	Redhead	X	X								
Aythya collaris	Ring-necked duck	X	X								
Aythya valisineria	Canvasback	X	X								
Branta canadensis	Canada goose		X	PO							X
Bucephala albeola	Bufflehead		X								
Bucephala clangula	Common goldeneye		X								
Chen caerulescens	Snow goose	X	X								
Cygnus columbianus	Tundra swan		X								
Lophodytes cucullatus	Hooded merganser	X	X								X
Mergus merganser	Common merganser		X								
Oxyura jamaicensis	Ruddy duck	X	X								
Cathartidae	**American vultures**										
Cathartes aura	Turkey vulture	X	X	PO	X2	X1	X1				X
Accipitridae	**Kites, eagles, and hawks**										
Accipiter cooperii[R]	Cooper's hawk	X	X								X
Accipiter striatus[R]	Sharp-shinned hawk	X	X								X
Aquila chrysaetos	Golden eagle		X								
Buteo jamaicensis	Red-tailed hawk	X	X	PR							X
Buteo lineatus[WL]	Red-shouldered hawk		X		X4			X1			X

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Buteo platypterus	Broad-winged hawk	X	X		X1					X1	X
Circus cyaneus[E]	Northern harrier	X	X								
Haliaeetus leucocephalus[LT,E]	Bald eagle		X								
Pandion haliaetus[EXT]	Osprey	X	X								X
Falconidae	**Falcons**										
Falco columbarius	Merlin	X	X								
Falco sparverius	American kestrel	X	X								X
Phasianidae	**Grouse, turkeys and quail**										
Bonasa umbellus	Ruffed grouse		X								
Colinus virginianus	Northern bobwhite		X	CO	X6	X6	X3		X1		X
Meleagris gallopavo	Wild turkey		X	PR	X5	X6	X2				X
Rallidae	**Rails and others**										
Fulica americana	American coot	X	X				X1				X
Gallinula chloropus[R]	Common moorhen	X					X1				
Porzana carolina[SU]	Sora	X	X								
Rallus limicola	Virginia rail	X	X								
Scolopacidae	**Sandpipers**										
Actitis macularia	Spotted sandpiper	X	X								
Calidris minutilla	Least sandpiper	X	X								
Calidris pusilla	Semipalmated sandpiper	X	X								
Charadrius vociferus	Killdeer	X	X	PO		X1					X

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Gallinago gallinago	Common snipe	X	X								
Phalaropus tricolor	Wilson's phalarope	X	X								
Scolopax minor	American woodcock		X							X1	
Tringa flavipes	Lesser yellowlegs	X	X								
Tringa melanoleuca	Greater yellowlegs	X	X								
Laridae	**Gulls and terns**										
Larus argentatus	Herring gull	X	X								
Larus atricilla	Laughing gull	X	X								
Sterna caspia	Caspian tern	X	X								
Sterna forsteri	Forster's tern	X	X								
Columbidae	**Pigeons and doves**										
Columba livia	Rock dove		X								X
Zenaida macroura	Mourning dove	X	X	PO	X5	X3	X3				X
Cuculidae	**Cuckoos and roadrunners**										
Coccyzus erythropthalmus	Black-billed cuckoo	X	X								
Coccyzus americanus	Yellow-billed cuckoo	X	X	CO	X6		X4	X1-OUT			X
Tytonidae	**Barn owls**										
Tyto alba[R]	Barn owl		X								
Strigidae	**Typical owls**										
Bubo virginianus	Great horned owl		X	PR							X
Otus asio	Eastern screech-owl		X								

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Strix varia	Barred owl		X		X2						X
Caprimulgidae	**Goatsuckers**										
Caprimulgus carolinensis	Chuck-will's-widow	X	X	PR							X
Caprimulgus vociferus	Whip-poor-will	X	X	PR			X1				X
Chordeiles minor	Common nighthawk	X	X								X
Trochilidae	**Hummingbirds**										
Archilochus colubris	Ruby-throated hummingbird	X	X	PO	X3	X1		X5	X4	X5	X
Alcedinidae	**Kingfishers**										
Ceryle alcyon	Belted kingfisher	X	X	PR	X1	X3	X1				X
Picidae	**Woodpeckers**										
Colaptes auratus	Northern flicker		X	PR	X1	X4					X
Dryocopus pileatus	Pileated woodpecker		X	PO	X6	X6	X3	X1	X2	X2	X
Melanerpes carolinus	Red-bellied woodpecker		X	PO	X6	X5	X5		X3	X1	X
Melanerpes erythrocephalus	Red-headed woodpecker		X								X
Picoides pubescens	Downy woodpecker		X	PO	X6	X6	X4	X5	X4	X3	X
Picoides villosus	Hairy woodpecker		X		X4	X1	X1	X2			X
Sphyrapicus varius	Yellow-bellied sapsucker		X								
Tyrannidae	**Tyrant flycatchers**										
Contopus virens	Eastern wood-pewee	X	X	CO	X6	X6	X4	X1	X3	X4	X
Empidonax alnorum	Alder flycatcher	X	X								
Empidonax minimus	Least flycatcher	X	X								

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Empidonax traillii	Willow flycatcher	X	X			X2	X1	X2-OUT	X2-OUT	X4	
Empidonax virescens	Acadian flycatcher	X	X		X5		X5	X6	X6	X6	X
Empidonax spp.		X				X4	X1			X1	
Myiarchus crinitus	Great crested flycatcher	X	X	CO	X5	X5	X4		X1		X
Tyrannus forficatus	Scissor-tailed flycatcher	X	X								
Tyrannus tyrannus	Eastern kingbird	X	X	CO		X1	X1				X
Sayornis phoebe	Eastern phoebe	X	X	PO	X2	X2	X2	X1	X1	X2	X
Alaudidae	**Larks**										
Eremophila alpestris	Horned lark		X								X
Apodidae	**Swifts**										
Chaetura pelagica	Chimney swift	X	X	PR	X1						
Hirundinidae	**Swallows**										
Hirundo pyrrhonota	Cliff swallow	X	X								
Hirundo rustica	Barn swallow	X	X	CO							X
Progne subis	Purple martin	X	X								X
Stelgidopteryx serripennis	Northern rough-winged swallow	X	X				X1				X
Tachycineta bicolor	Tree swallow	X	X								X
Corvidae	**Jays and crows**										
Corvus brachyrhynchos	American crow		X	PO	X6	X6	X3		X1		X
Cyanocitta cristata	Blue jay		X	PO	X6	X6	X1	X1	X2	X1	X
Paridae	**Titmice**										

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Parus atricapillus	Black-capped chickadee		X		X2	X5	X3		X4		X
Parus bicolor	Tufted titmouse		X	CO	X6	X6	X6	X5	X6	X3	X
Parus carolinensis	Carolina chickadee		X	PR	X6	X2	X4	X5	X6	X4	X
Parus spp.	Unidentified chickadee					X5	X4				
Sittidae	**Nuthatches**										
Sitta canadensis	Red-breasted nuthatch		X								X
Sitta carolinensis	White-breasted nuthatch		X	PO	X4	X5	X4			X1	X
Certhiidae	**Creepers**										
Certhia americana[SU]	Brown creeper		X								X1
Troglodytidae	**Wrens**										
Cistothorus palustris[SU]	Marsh wren	X									X
Cistothorus platensis	Sedge wren	X									X
Thryomanes bewickii[WL]	Bewick's wren		X	CO		X1	X4	X2			X
Thryothorus ludovicianus	Carolina wren		X	CO	X5	X6	X5	X4	X6	X4	X
Troglodytes aedon	House wren	X	X	CO		X1	X1				
Troglodytes troglodytes	Winter wren		X								
Mimidae	**Mockingbirds and thrashers**										
Dumetella carolinensis	Gray catbird	X	X	CO	X1	X3	X2		X2	X1	X
Mimus polyglottos	Northern mockingbird		X								X
Toxostoma rufum	Brown thrasher		X	PR		X3		X1	X1		X
Muscicapidae	**Muscicapids**										

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Catharus fuscescens	Veery	X	X						X1	X2	
Catharus guttatus	Hermit thrush	X	X								
Catharus minimus	Gray-cheeked thrush	X	X								
Catharus ustulatus	Swainson's thrush	X	X								
Hylocichla mustelina	Wood thrush	X	X		X3	X4	X4	X4	X4	X4	X
Polioptila caerulea	Blue-gray gnatcatcher	X	X	CO	X6	X6	X6	X4	X6	X3	X
Regulus calendula	Ruby-crowned kinglet	X	X								
Regulus satrapa	Golden-crowned kinglet		X								X
Sialia sialis	Eastern bluebird		X	CO	X1	X1	X1	X1		X1	X
Turdus migratorius	American robin	X	X	CO		X6	X2		X1		X
Bombycillidae	**Waxwings**										
Bombycilla cedrorum	Cedar waxwing	X	X	CO							X
Sturnidae	**Starlings**										
Sturnus vulgaris	European starling		X	PO							X
Vireonidae	**Vireos**										
Vireo bellii[WL]	Bell's vireo	X	X								X
Vireo flavifrons	Yellow-throated vireo	X	X	PO	X1	X4	X3		X1		X
Vireo gilvus	Warbling vireo	X	X			X1	X3				X
Vireo griseus	White-eyed vireo	X	X	PR	X4	X6	X5	X4	X4	X3	X
Vireo olivaceus	Red-eyed vireo	X	X	PR	X6	X6	X6	X6	X6	X5	X
Vireo solitarius	Solitary vireo	X	X								

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Emberizidae	**Emberizids**										
Agelaius phoeniceus	Red-winged blackbird	X	X	CO	X1	X4	X3				X
Aimophila aestivalis	Bachman's sparrow		X?								
Ammodramus savannarum	Grasshopper sparrow	X	X								
Cardinalis cardinalis	Northern cardinal		X	CO	X6	X6	X5	X6	X5	X4	X
Chondestes grammacus	Lark sparrow	X	X	PR							
Dendroica castanea	Bay-breasted warbler	X	X								
Dendroica cerulea[WL]	Cerulean warbler	X	X		X3	X3	X3	X1-OUT	X2	X2	X
Dendroica coronata	Yellow-rumped warbler	X	X								X
Dendroica discolor	Prairie warbler	X	X	PO	X3	X5	X3	X3	X3	X3	X
Dendroica dominica	Yellow-throated warbler	X	X		X2	X1	X1	X1			X
Dendroica fusca	Blackburnian warbler	X	X								
Dendroica magnolia	Magnolia warbler	X	X								
Dendroica palmarum	Palm warbler	X	X								
Dendroica pensylvanica[SU]	Chestnut-sided warbler	X	X								X
Dendroica petechia	Yellow warbler	X	X			X2	X2	X1			X
Dendroica pinus	Pine warbler	X	X	CO	X1	X1	X1				X
Dendroica striata	Blackpoll warbler	X	X								
Dendroica virens	Black-throated green warbler	X	X								
Dolichonyx oryzivorus	Bobolink	X	X								
Geothlypis trichas	Common yellowthroat	X	X	PR	X4	X6	X5	X3	X3	X4	X

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Guiraca caerulea	Blue grosbeak	X		PR							
Helmitheros vermivorus	Worm-eating warbler	X	X		X2	X2	X2	X5	X6	X4	X
Icteria virens	Yellow-breasted chat	X	X	CO	X5	X5	X4	X4	X5	X3	X
Icterus galbula	Baltimore oriole	X	X								X
Icterus spurius	Orchard oriole	X	X	CO	X1			X1	X2	X2	X
Junco hyemalis	Dark-eyed junco		X			X1					X
Limnothlypis swainsonii[E]	Swainson's warbler	X	X								
Melospiza melodia	Song sparrow		X								X
Mniotilta varia	Black-and-white warbler	X	X	CO	X6	X5	X3	X5	X6	X5	X
Molothrus ater	Brown-headed cowbird	X	X	PR	X6	X3	X5	X1	X1	X3	X
Oporornis agilis	Connecticut warbler	X	X								
Oporornis formosus	Kentucky warbler	X	X	PO	X5	X6	X3	X6	X5	X5	X
Oporornis philadelphia	Mourning warbler	X	X							X2	
Parula americana	Northern parula	X	X	CO	X4	X4	X6	X4	X4	X4	X
Passerculus sandwichensis[SU]	Savannah sparrow	X	X								
Passerella iliaca	Fox sparrow		X								
Passerina cyanea	Indigo bunting	X	X	CO	X6	X6	X4	X5	X6	X5	X
Pheucticus ludovicianus	Rose-breasted grosbeak	X	X								X
Pipilo erythrophthalmus	Eastern towhee	X	X	CO	X5	X5	X4	X4	X1	X3	X
Piranga olivacea	Scarlet tanager	X	X		X1	X1		X3		X1	X
Piranga rubra	Summer tanager	X	X	PR	X3	X5	X1	X3	X3	X2	X

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Protonotaria citrea	Prothonotary warbler	X	X		X1	X1	X1	X1		X1	X
Quiscalus quiscula	Common grackle		X	CO		X2	X1				X
Seiurus aurocapillus	Ovenbird	X	X	CO	X5	X5	X4	X6	X5	X6	X
Seiurus motacilla	Louisiana waterthrush	X	X			X1	X1	X1	X2	X2	X
Seiurus noveboracensis	Northern waterthrush	X	X								
Setophaga ruticilla	American redstart	X	X		X6	X4	X1	X3	X3	X1	X
Spiza americana	Dickcissel	X	X								
Spizella arborea	American tree sparrow		X								
Spizella passerina	Chipping sparrow	X	X	PR	X1	X2					X
Spizella pusila	Field sparrow		X	CO	X4	X3	X3	X3	X3	X3	X
Sturnella magna	Eastern meadowlark	X	X	PO			X1				X
Vermicora celata	Orange-crowned warbler	X	X								
Vermivora chrysoptera	Golden-winged warbler	X	X								
Vermivora peregrina	Tennessee warbler	X	X								
Vermivora pinus	Blue-winged warbler	X	X	PR	X4	X5	X5	X5	X4	X5	X
Vermivora ruficapilla	Nashville warbler	X	X								
Wilsonia canadensis	Canada warbler	X	X								X
Wilsonia citrina	Hooded warbler	X	X			X1					X
Wilsonia pusilla	Wilson's warbler	X	X								
Zonotrichia albicollis	White-throated sparrow		X								X
Zonotrichia leucophrys	White-crowned sparrow	X	X								

SCIENTIFIC NAME[1]	COMMON NAME[1]	NM[2]	FLW/ LCTA[3]	BBA[4]	MAPS-93 PC[5]	MAPS-94 PC[5]	MAPS-95 PC[5]	MAPS-93NET[6]	MAPS-94NET[6]	MAPS-95NET[6]	MDC 94-95[7]
Fringillidae	**Fringilline and cardueline finches and allies**										
Carduelis tristis	American goldfinch	X	X	PR	X1	X3	X4	X3	X3	X3	X
Carpodacus purpureus	Purple finch		X								X
Coccothraustes vespertinus	Evening grosbeak		X								
Passeridae	**Old World sparrows**										
Passera domesticus	House sparrow		X								X
Total Number of Species	**199**	**144**	**194**	**64**	**60**	**68**	**68**	**45**	**45**	**46**	**114**

[1]Nomenclature follows American Ornithologist's Union (1983) with occasional updates.
[2]NM - Neotropical migrant
[3]FLW files and LCTA data; X indicates species observed
[4]Breeding Bird Atlas, 1991, 1992; PO = possible breeding, PR = probable breeding, and CO = confirmed breeding.
[5]MAPS point-count data from 1993 or 1994; X1 indicates bird was seen at 1 of 6 point count sites, X2 = 2 of 6 sites, etc.
[6]MAPS mist-net data from 1993 or 1994; X1 indicates bird was seen at 1 of 6 mist net sites, X2 = 2 of 6 sites, etc.
OUT indicates all observations made outside of accepted safe dates for reproduction.
[7]MDC bird survey, 1994 and 1995; X indicates species observed
[E]Missouri status - Endangered
[LT]Federal - Threatened
[EXT]Missouri status - Extirpated
[SU]Missouri status - Status Undetermined
[R]Missouri status - Rare
[WL]Missouri status - Watch List

Table 17. Reproductive status of bird species reported from FLW, Pulaski Co., MO.

Scientific Name	Common Name	Neotropical Migrant	Reproductive Status
Gaviidae	**Loons**		
Gavia immer	Common loon		
Podicipedidae	**Grebes**		
Podiceps auritus	Horned grebe		
Podilymbus podiceps	Pied-billed grebe	X	
Phalacrocoracidae	**Cormorants**		
Phalacrocorax auritus	Double-crested cormorant	X	
Ardeidae	**Bitterns and herons**		
Ardea albus	Great egret	X	
Ardea herodias	Great blue heron	X	Confirmed
Bubulcus ibis	Cattle egret	X	
Butorides virescens	Green heron	X	Probable
Egretta thula	Snowy egret	X	
Nyctanessa violaceus	Yellow-crowned night heron	X	Possible
Anatidae	**Swans, geese, and ducks**		
Aix sponsa	Wood duck	X	Confirmed
Anas acuta	Northern pintail	X	
Anas americana	American wigeon	X	
Anas clypeata	Northern shoveler	X	
Anas crecca	Green-winged teal	X	
Anas discors	Blue-winged teal	X	
Anas platyrhynchos	Mallard	X	
Anas strepera	Gadwall	X	
Aythya affinis	Lesser scaup	X	
Aythya americana	Redhead	X	
Aythya collaris	Ring-necked duck	X	
Aythya valisineria	Canvasback	X	
Branta canadensis	Canada goose		
Bucephala albeola	Bufflehead		
Bucephala clangula	Common goldeneye		
Chen caerulescens	Snow goose	X	

Scientific Name	Common Name	Neotropical Migrant	Reproductive Status
Cygnus columbianus	Tundra swan		
Lophodytes cucullatus	Hooded merganser	X	
Mergus merganser	Common merganser		
Oxyura jamaicensis	Ruddy duck	X	
Cathartidae	**American vultures**		
Cathartes aura	Turkey vulture	X	Confirmed
Accipitridae	**Kites, eagles, and hawks**		
Accipiter cooperii	Cooper's hawk	X	Confirmed
Accipiter striatus	Sharp-shinned hawk	X	Confirmed
Aquila chrysaetos	Golden eagle		
Buteo jamaicensis	Red-tailed hawk	X	Confirmed
Buteo lineatus	Red-shouldered hawk		Confirmed
Buteo platypterus	Broad-winged hawk	X	Possible
Circus cyaneus	Northern harrier	X	
Haliaeetus leucocephalus	Bald eagle		
Pandion haliaetus	Osprey	X	
Falconidae	**Falcons**		
Falco columbarius	Merlin	X	
Falco sparverius	American kestrel	X	Possible
Phasianidae	**Grouse, turkeys and quail**		
Bonasa umbellus	Ruffed grouse		Possible
Colinus virginianus	Northern bobwhite		Confirmed
Meleagris gallopavo	Wild turkey		Confirmed
Rallidae	**Rails and others**		
Fulica americana	American coot	X	
Gallinula chloropus	Common moorhen	X	
Porzana carolina	Sora	X	
Rallua limicola	Virginia rail	X	
Scolopacidae	**Sandpipers**		
Actitis macularia	Spotted sandpiper	X	

Scientific Name	Common Name	Neotropical Migrant	Reproductive Status
Calidris minutilla	Least sandpiper	X	
Calidris pusilla	Semipalmated sandpiper	X	
Charadrius vociferus	Killdeer	X	Confirmed
Gallinago gallinago	Common snipe	X	Possible
Phalaropus tricolor	Wilson's phalarope	X	
Scolopax minor	American woodcock		Possible
Tringa flavipes	Lesser yellowlegs	X	
Tringa melanoleuca	Greater yellowlegs	X	
Laridae	**Gulls and terns**		
Larus argentatus	Herring gull	X	
Larus atricilla	Laughing gull	X	
Sterna caspia	Caspian tern	X	
Sterna forsteri	Forster's tern	X	
Columbidae	**Pigeons and doves**		
Columba livia	Rock dove		Confirmed
Zenaida macroura	Mourning dove	X	Possible
Cuculidae	Cuckoos and roadrunners		
Coccyzus erythropthalmus	Black-billed cuckoo	X	
Coccyzus americanus	Yellow-billed cuckoo	X	Confirmed
Tytonidae	**Barn owls**		
Tyto alba	Barn owl		
Strigidae	**Typical owls**		
Bubo virginianus	Great horned owl		Possible
Otus asio	Eastern screech-owl		Possible
Strix varia	Barred owl		Possible
Caprimulgidae	**Goatsuckers**		
Caprimulgus carolinensis	Chuck-will's-widow	X	Possible
Caprimulgus vociferus	Whip-poor-will	X	Possible
Chordeiles minor	Common nighthawk	X	Possible
Trochilidae	**Hummingbirds**		
Archilochus colubris	Ruby-throated hummingbird	X	Confirmed

Scientific Name	Common Name	Neotropical Migrant	Reproductive Status
Alcedinidae	**Kingfishers**		
Ceryle alcyon	Belted kingfisher	X	Confirmed
Picidae	**Woodpeckers**		
Colaptes auratus	Northern flicker		Possible
Dryocopus pileatus	Pileated woodpecker		Confirmed
Melanerpes carolinus	Red-bellied woodpecker		Confirmed
Melanerpes erythrocephalus	Red-headed woodpecker		Possible
Picoides pubescens	Downy woodpecker		Confirmed
Picoides villosus	Hairy woodpecker		Confirmed
Sphyrapicus varius	Yellow-bellied sapsucker		
Tyrannidae	**Tyrant flycatchers**		
Contopus virens	Eastern wood-peewee	X	Confirmed
Empidonax alnorum	Alder flycatcher	X	
Empidonax minimus	Least flycatcher	X	
Empidonax traillii	Willow flycatcher	X	Confirmed
Empidonax virescens	Acadian flycatcher	X	Confirmed
Empidonax spp.		X	
Myiarchus crinitus	Great crested flycatcher	X	Confirmed
Tyrannus forficatus	Scissor-tailed flycatcher	X	
Tyrannus tyrannus	Eastern kingbird	X	Possible
Sayornis phoebe	Eastern phoebe	X	Confirmed
Alaudidae	**Larks**		
Eremophila alpestris	Horned lark		
Apodidae	**Swifts**		
Chaetura pelagica	Chimney swift	X	Possible
Hirundinidae	**Swallows**		
Hirundo pyrrhonota	Cliff swallow	X	Possible
Hirundo rustica	Barn swallow	X	Confirmed
Progne subis	Purple martin	X	Possible
Stelgidopteryx serripennis	Northern rough-winged swallow	X	Confirmed

Scientific Name	Common Name	Neotropical Migrant	Reproductive Status
Tachycineta bicolor	Tree swallow	X	Possible
Corvidae	**Jays and crows**		
Corvus brachyrhynchos	American crow		Confirmed
Cyanocitta cristata	Blue jay		Confirmed
Paridae	**Titmice**		
Parus atricapillus	Black-capped chickadee		Confirmed
Parus bicolor	Tufted titmouse		Confirmed
Parus carolinensis	Carolina chickadee		Confirmed
Parus spp.	Unidentified chickadee		
Sittidae	**Nuthatches**		
Sitta canadensis	Red-breasted nuthatch		
Sitta carolinensis	White-breasted nuthatch		Possible
Certhiidae	**Creepers**		
Certhia americana	Brown creeper		Confirmed
Troglodytidae	**Wrens**		
Cistothorus palustris	Marsh wren	X	
Cistothorus platensis	Sedge wren	X	
Thryomanes bewickii	Bewick's wren		Confirmed
Thyrothorus ludovicianus	Carolina wren		Confirmed
Troglodytes aedon	House wren	X	Possible
Troglodytes troglodytes	Winter wren		
Mimidae	**Mockingbirds and thrashers**		
Dumetella carolinensis	Gray catbird	X	Confirmed
Mimus polyglottos	Northern mockingbird		Confirmed
Toxostoma rufum	Brown thrasher		Confirmed
Muscicapidae	**Muscicapids**		
Catharus fuscescens	Veery	X	Possible
Catharus guttatus	Hermit thrush	X	
Catharus minimus	Gray-cheeked thrush	X	Possible
Catharus ustulatus	Swainson's thrush	X	
Hylocichla mustelina	Wood thrush	X	Confirmed

Scientific Name	Common Name	Neotropical Migrant	Reproductive Status
Polioptila caerulea	Blue-gray gnatcatcher	X	Confirmed
Regulus calendula	Ruby-crowned kinglet	X	
Regulus satrapa	Golden-crowned kinglet		
Sialia sialis	Eastern bluebird		Confirmed
Turdus migratorius	American robin	X	Confirmed
Bombycillidae	**Waxwings**		
Bombycilla cedrorum	Cedar waxwing	X	
Sturnidae	**Starlings**		
Sturnus vulgaris	European starling		Confirmed
Vireonidae	**Vireos**		
Vireo bellii	Bell's vireo	X	Possible
Vireo flavifrons	Yellow-throated vireo	X	Confirmed
Vireo gilvus	Warbling vireo	X	Possible
Vireo griseus	White-eyed vireo	X	Confirmed
Vireo olivaceus	Red-eyed vireo	X	Confirmed
Vireo solitarius	Solitary vireo	X	
Emberizidae	**Emberizids**		
Agelaius phoeniceus	Red-winged blackbird	X	Possible
Aimophila aestivalis	Bachman's sparrow		
Ammodramus savannarum	Grasshopper sparrow	X	Possible
Cardinalis cardinalis	Northern cardinal		Confirmed
Chondestes grammacus	Lark sparrow	X	Possible
Dendroica castanea	Bay-breasted warbler	X	
Dendroica cerulea	Cerulean warbler	X	Confirmed
Dendroica coronata	Yellow-rumped warbler	X	Confirmed
Dendroica discolor	Prairie warbler	X	Confirmed
Dendroica dominica	Yellow-throated warbler	X	Confirmed
Dendroica fusca	Blackburnian warbler	X	
Dendroica magnolia	Magnolia warbler	X	
Dendroica palmarum	Palm warbler	X	
Dendroica pensylvanica	Chestnut-sided warbler	X	

Scientific Name	Common Name	Neotropical Migrant	Reproductive Status
Dendroica petechia	Yellow warbler	X	Possible
Dendroica pinus	Pine warbler	X	Possible
Dendroica striata	Blackpoll warbler	X	
Dendroica virens	Black-throated green warbler	X	
Dolichonyx oryzivorus	Bobolink	X	
Geothlypis trichas	Common yellowthroat	X	Confirmed
Guiraca caerulea	Blue grosbeak	X	Possible
Helmitheros vermivorus	Worm-eating warbler	X	Confirmed
Icteria virens	Yellow-breasted chat	X	Confirmed
Icterus galbula	Baltimore oriole	X	Possible
Icterus spurius	Orchard oriole	X	Confirmed
Junco hyemalis	Dark-eyed junco		
Limnothlypis swainsonii	Swainson's warbler	X	
Melospiza melodia	Song sparrow		
Mniotilta varia	Black-and-white warbler	X	Confirmed
Molothrus ater	Brown-headed cowbird	X	Confirmed
Oporornis agilis	Connecticut warbler	X	
Oporornis formosus	Kentucky warbler	X	Confirmed
Oporornis philadelphia	Mourning warbler	X	Possible
Parula americana	Northern parula	X	Confirmed
Passerculus sandwichensis	Savannah sparrow	X	
Passerella iliaca	Fox sparrow		
Passerina cyanea	Indigo bunting	X	Confirmed
Pheucticus ludovicianus	Rose-breasted grosbeak	X	
Pipilo erythrophthalmus	Eastern towhee	X	Confirmed
Piranga olivacea	Scarlet tanager	X	Confirmed
Piranga rubra	Summer tanager	X	Confirmed
Protonotaria citrea	Prothonotary warbler	X	Confirmed
Quiscalus quiscula	Common grackle		Confirmed
Seiurus aurocapillus	Ovenbird	X	Confirmed
Seiurus motacilla	Louisiana waterthrush	X	Confirmed

Scientific Name	Common Name	Neotropical Migrant	Reproductive Status
Seiurus noveboracensis	Northern waterthrush	X	
Setophaga ruticilla	American redstart	X	Confirmed
Spiza americana	Dickcissel	X	Possible
Spizella arborea	American tree sparrow		
Spizella passerina	Chipping sparrow	X	Possible
Spizella pusila	Field sparrow		Confirmed
Sturnella magna	Eastern meadowlark	X	Confirmed
Vermicora celata	Orange-crowned warbler	X	
Vermivora chrysoptera	Golden-winged warbler	X	
Vermivora peregrina	Tennessee warbler	X	
Vermivora pinus	Blue-winged warbler	X	Confirmed
Vermivora ruficapilla	Nashville warbler	X	
Wilsonia canadensis	Canada warbler	X	
Wilsonia citrina	Hooded warbler	X	Possible
Wilsonia pusilla	Wilson's warbler	X	
Zonotrichia albicollis	White-throated sparrow		
Zonotrichia leucophrys	White-crowned sparrow	X	
Fringillidae	**Fringilline and finches and allies**		
Carduelis tristis	American goldfinch	X	Confirmed
Carpodacus purpureus	Purple finch		
Coccothraustes vespertinus	Evening grosbeak		
Passeridae	**Old world sparrows**		
Passera domesticus	House sparrow		Confirmed

Table 18. Location and general habitat description of bird survey stations established by MAPS personnel.

Station	Major Habitat Type
Big Piney	Bottomland riparian forest, open fields, scrublands
Laughlin Bottoms	Old field complex, walnut plantation, deciduous forest, mature riparian forest
Miller Ponds	Old field complex, deciduous forest of varying ages, ponds, mowed firebreaks
Macedonia	Old field complex, cedar brakes, secondary woodland
Smith Ridge	Upland deciduous forest, small pine plantation
Miller Ridge	Mature deciduous forest

Source: DeSante, Walker, and Burton 1994.

Table 19. Most abundant species on FLW.

Rank	1993	1995
1	Indigo bunting	Blue-winged warbler
2	Blue-gray gnatcatcher	Red-eyed vireo
3	Red-eyed vireo	Blue-gray gnatcatcher
4	American crow	American crow
5	Northern cardinal	Field sparrow
6	Yellow-breasted chat	Yellow-breasted chat
7	Brown-headed cowbird	Indigo bunting
8	Field sparrow	Eastern tufted titmouse
9	Blue-winged warbler	Eastern towhee
10	Acadian flycatcher	Northern cardinal

Table 20. Rare and endangered bird species surveyed for on FLW, Pulaski Co., MO, during 1994-1995, and survey results.

Scientific Name	Common Name	Fed/State	Observed on FLW
Accipiter cooperii	Cooper's hawk	--/R	X
Accipiter striatus	Sharp-shinned hawk	--/R	X
Aimophila aestivalis	Bachman's sparrow	C2/E	
Ammodramus henslowii	Henslow's sparrow	C2/R	
Ardea herodias	Great blue heron rookery	--/--	X
Buteo lineatus	Red-shouldered hawk	--/WL	X
Certhia americana	Brown Creeper	--/SU	X
Dendroica cerulea	Cerulean warbler	C2/WL	X
Haliaeetus leucocephalus	Bald eagle	T/E	
Lanius ludovicianus	Loggerhead shrike	--/WL	
Nycticorax nycticoras	Black-crowned night-heron	--/R	
Thryomanes bewickii	Bewick's wren	--/WL	X
Tyto alba	Barn owl	--/R	
Vireo bellii	Bell's vireo	--/WL	X

Table 21. Federally and state-listed birds found on FLW, Pulaski Co., between May 1994 and October 1995.

SCIENTIFIC NAME	COMMON NAME	STATUS FED.	STATUS STATE	T	R	S	DATE OBS.	COMMENTS
Accipiter cooperii	Cooper's hawk	--	Rare	34N	11W	29	06/16/94	One pair; south of Musgrave Hollow
Accipiter cooperii	Cooper's hawk	--	Rare	35N	10W	31	09/01/94	Two adults; quarry on Big Piney River
Accipiter cooperii	Cooper's hawk	--	Rare	34N	11W	28	04/20/95	One adult; Musgrave Hollow Spring
Accipiter cooperii	Cooper's hawk	--	Rare	34N	11W	2	04/24/95	Two adults; McCourtney Hollow
Accipiter cooperii	Cooper's hawk	--	Rare	34N	11W	29	07/20/95	Three birds, same size; south of Musgrave Hollow
Accipiter striatus	Sharp-shinned hawk	--	Rare	34N	12W	34	07/12/94	One bird; Macedonia Cemetary
Accipiter striatus	Sharp-shinned hawk	--	Rare	34N	11W	6	08/28/94	One bird; Penns Pond
Accipiter striatus	Sharp-shinned hawk	--	Rare	34N	11W	6	09/21/94	One bird; Penns Pond
Accipiter striatus	Sharp-shinned hawk	--	Rare	34N	12W	27	07/29/95	One bird; south of Mush Paddle Hollow
Accipiter spp.		--	Rare	35N	11W	35	05/03/95	Nesting attempt. Two chicks hatched 6/4/94, no activity after 6/14/95. Young probably taken by predator. West of TA 194.
Buteo lineatus	Red-shouldered hawk	--	Watch List	35N	10W	32	06/15/94	Two adults, one juvenile; Big Piney River slough
Buteo lineatus	Red-shouldered hawk	--	Watch List	34N	12W	34	07/03/94	Three bird heard, one observed, Macedonia Cemetary
Buteo lineatus	Red-shouldered hawk	--	Watch List	35N	12W	24	05/09/95	One bird observed; Smith Branch
Buteo lineatus	Red-shouldered hawk	--	Watch List	35N	10W	32	05/12/95	One bird heard; Big Piney River slough
Buteo lineatus	Red-shouldered hawk	--	Watch List	35N	11W	8	06/07/95	One adult feeding two fledglings; Ballard Hollow
Pandion haliaetus	Osprey	--	Extirpated	34N	11W	2	04/24/95	One bird; spring migration; McCourtney Hollow
Podilymbus podiceps	Pied-billed grebe	--	Rare	34N	11W	4	09/16/94	Three birds; fall migration; Bloodland Lake
Podilymbus podiceps	Pied-billed grebe	--	Rare	34N	12W	34	09/29/94	Two birds; fall migration; Macedonia Cemetary
Casmerodius albus	Great egret	--	Rare	35N	10W	30	09/01/94	One bird; fall migration; Big Piney R. south of Pumping Station

SCIENTIFIC NAME	COMMON NAME	STATUS FED. STATE	T	R	S	DATE OBS.	COMMENTS
Thryomanes bewickii	Bewick's wren	-- Watch List	35N	11W	14	06/16/94	One singing adult; Cantonment area
Cistothorus palustris	Marsh wren	-- Status Und	34N	11W	6	09/21/94	One bird; fall migration; Penns Pond
Certhia americana	Brown creeper	-- Status Und	35N	11W	8	06/21/94	One adult feeding young; Ballard Hollow
Dendroica pennsylvanica	Chestnut-sided warbler	-- Watch List	35N	10W	30	05/10/95	One bird; spring migration; above Ramsey Cemetary
Dendroica cerulea	Cerulean warbler	C2 Watch List	35N	10W	29	06/02/94	Several birds heard; Big Piney R. Happy Hollow Bridge
Dendroica cerulea	Cerulean warbler	C2 Watch List	34N	11W	22	07/03/94	One adult male and two others (females or immatures) observed; Falls Hollow
Dendroica cerulea	Cerulean warbler	C2 Watch List	34N	12W	25	09/10/94	Several birds heard, one adult male observed; Roubidoux Creek
Dendroica cerulea	Cerulean warbler	C2 Watch List	35N	10W	30	06/15/95	One adult male and three others (females or immatures) observed; Big Piney River
Vireo Bellii	Bell's vireo	-- Watch List	35N	11W	33	07/29/95	One adult observed; Range 3

Note: C2 status is no longer used by USFWS.

Table 22. List of the bryophytes, lichens, and vascular flora identified on Falls Hollow Sandstone glades.

Listed below are the results of the floristic inventory at Falls Hollow. Bryophytes were determined by Dr. Paul Redfearn, and the lichens were determined by Doug Ladd of The Nature Conservancy. Determinations of vascular plants were made principally with Steyermark (1963). No manual is complete, however, and a number of other works were used to double check or, in some cases, to identify specimens. These were: *Flora of the Great Plains* (1990 edition) by the Great Plains Flora Association, *Manual of the Grasses of the United States* by A. S. Hitchcock (1971), *Manual of Vascular Plants of Northeastern United States and Adjacent Canada* (second edition, 1991) by Gleason and Cronquist, and *The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada* (Gleason 1952). In addition, two monographs were used, Robert Kral's Taxonomic Treatment of Abildgaardia spp., Bulbostylis spp., and Fimbristylis spp. of North America (1971), and Almut Jones' Aster and Brachyactis in Illinois (1989). Jones' work is especially helpful in correctly identifying species of Aster. Nomenclature and treatment of vascular plant groups follows. The *Catalogue of the Flora of Missouri* (1990) by Yatskievych and Turner with the exception of the treatment of Panicum spp., which follows Lelong (pers. comm.). Anyone serious about plant taxonomy in Missouri owes George Yatskievych and Joanna Turner a "thank you," for their book lessens considerably the amount of work needed to keep up with nomenclatural and other changes regarding the flora of Missouri.

After each taxon occurs three categories. The first of these is frequency of occurrence (FR) that is noted as follows: 1 = rare, 2 = occasional, 3 = common, 4 = abundant. The second category is habitat. Naturally, most species occurred on the "glade," but some were solely or also located in other sites, such as the border of the glade or on the temporary seeps. The last category is the date of collection (M/D/Y). Introduced species are denoted by an asterisk (*) before each taxon. Unless otherwise noted, plants occurred on all four glades. When a species was not collected on all four glades, the site of collection was noted by the designation given the glades in Figure 8 (i.e., SG1, SG2, etc.).

DIVISION ASCOMYCOTA, lichens
(Note: only six species could be determined at this point; unknowns will be determined at a later date)

Cladina sp.
C. cristatella Tuck. - FR=3; glade; 5/23/94.
Cladonia dimorphoclada Robbins - FR=3; glade; 5/23/94.
C. robbinsii Evens - FR=2; near Falls on SG1; 5/23/94.
Cladonia spp.
Caloplaca sp.
Dermatocarpon spp.
Parmotrema hypotropum (Nyl.) Hale
Peltigera cf. rufescens (Weiss) Humb. - FR=2; growing among mosses; 5/23/94.
Pseudoparmelia baltimorensis (Gyel. & For.) Hale - FR=2; glade; 5/23/94.

DIVISION BRYOPHYTA, mosses

Bryum capillare Hedw. - FR=1; near Falls on SG1; 5/23/94.
Entodon seductrix (Hedw.) Muell - Fr= 2; glade; 5/23/94.
Grimmia laevigata (Brid.) Brid. - FR= 2 ; glade; 5/23/94.
Hedwigia cilliata (Hedw.) Ehrh. ex P. Beauv. - FR= 2; glade; 5/23/94.
Polytrichium juniperinum Hedw. - FR= 3; moist, shady areas; 5/23/94.

DIVISION PTERIDOPHYTA, ferns and fern allies

Adiantaceae

Chellanthes lanosa (Michaux) D. Eaton - FR=2; moist sandstone ledges; 7/16/94.

Aspleniaceae

Asplenium platyneuron (L.) Britton, Sterns & Pogg. var. platyneuron - FR=2; moist sandstone ledges; 7/16/94.

Dryopteridaceae

Cystopteris tennesseensis Shaver - FR=1; moist sandstone ledge on SG1; 7/16/94.
Dryopteris marginalis (L.) A. Gray - FR=3; moist sandstone ledge on SG1; 7/16/94.

DIVISION PINOPHYTA, conifers

Cupressaceae

Juniperus virginiana L. var. *virginiana* - FR=2; glade, border of glade; 10/7/94.

DIVISION MAGNOLIOPHYTA, flowering plants

CLASS MAGNOLIOPSIDA, dicots

Acanthaceae

Ruellia humilis Nutt. - FR=3; glade; 7/3/94.

Aceraceae

Acer rubrum L. - FR=2; moist ledge near falls on SG1; 10/7/94.

Anacardiaceae

Rhus aromatica Aiton - FR=2; along higher portions of gravel bar and drier parts of stream bank on SG1 and near border of glade on SG2; 4/1/94.
Rhus copallina L. - FR=2; glade; 7/16/94.
Rhus glabra L. - FR=2; edge of glade on SG1; 7/16/94.
Toxicodendron radicans (L.) Kuntze - FR=2; along stream bank in shady areas; 7/16/94.

Apiaceae

Chaerophyllum procumbens (L.) Crantz - FR=2; along stream banks; 5/13/94.
Eryngium yuccifolium Michaux - FR=1; glade on SG1; 8/5/94.

Apocynaceae

Amsonia illustris Woodson - FR=2; along gravel bar and stream bank on SG1; 4/24/94.

Asclepiadaceae

Asclepias tuberosa L. - FR=1; border of glade on SG1; 7/9/94.
Asclepias viridiflora Raf. - FR=1; seep on SG1; 7/9/94.

Asteraceae

Achillea millefolium L. var. lanulosa (Nutt.) Piper ex Piper & Beattie - FR=3; border of glade; 5/23/94.
Ambrosia artemisiifolia L. - FR=4; glade; 8/28/94.
A. bidentata Michaux - FR=4; glade; 8/28/94. NOTE: both species of *Ambrosia* were the two most numerous plants that occurred on the SG1.
Antennaria plantaginifolia (L.) Hook - FR=2; border of glade; 4/24/94.
Aster anomolus Engelm. f. anomolus - FR=2; border of glade; 9/18/94.
Aster lateriflorus (L.) Britton - FR=2; border of glade on rock exposures on SG1; 9/18/94.
Aster linariifolius L. var. *linariifolius* f. *linariifolius* - FR=2; glade, border of glade; 9/23/94.
Aster oolentangiensis Riddell var. *oolentangiensis* - FR=1; moist, shady spot on sandstone near falls on SG1; 9/30/94.
Aster patens Dryander - FR=1; glade on SG1; 8/28/94.
Aster pilosus Willd. - FR=3; glade, border of glade; 9/18/94.
Aster sericeus Vent f. *sericeus* - FR=2; in rocky, fragmented soil on northern border of SG1 and SG4; 9/9/94.
Bidens aristosa (Michaux) Britton f. *aristosa* - FR=3; glade, border of glade on SG1; 8/28/94.

Cacalia plantaginea (Raf.) Shinn. - FR=1; border of glade on SG1; 6/18/94.
Coreopsis lanceolata L. - FR=3; border of glade; 5/28/94.
Erigeron strigosus Muhlenb. ex Willd var. *beyrichii* Torrey & A. Gray - FR=3; glade, border of glade; 6/18/94.
Gnaphalium obtusifolium L. var. *obtusifolium* - FR=2; edge of glade; 9/18/94.
Helianthus mollis Lam. - FR=3; glade, border of glade on SG1; 8/6/94.
Heliopsis helianthoides (L.) Sweet var. *occidentalis* (T. Fisher) Steyerm. - FR=2; glade on SG1; 8/21/94.
Hieracium gronovii L. - FR=2; glade, especially under cedars; 8/3/94.
Krigia biflora (Walter) S.F. Blake - FR=2; border of glade on SG1 and SG3; 5/13/94.
K. dandelion (L.) Nutt. - FR=2; glade; 5/8/94.
K. virginica (L.) Willd. - FR=3; glade; 4/24/94.
Liatris pycnostachya Michaux var. *pycnostachya* - FR=3; border of glade on SG1 in moist soil; 7/16/94.
Parthenium hispidum Raf. - FR=3; glade, border of glade on SG1; 6/12/94.
Rudbeckia missouriensis Pursh - FR=3; glade; 7/30/94.
Solidago nemoralis Dryander - FR=2; glade; 8/28/94.
S. petiolaris Aiton - FR=3; eastern most part of SG1 in sandy soil; 9/29/94.
S. ulmifolia Muhlenb. ex Willd. - FR=2; glade; 8/28/94.
Vernonia arkansana DC. - FR=1; border of glade; 8/5/94.

Betulaceae

Carpinus caroliniana Walter - FR=2; border of glade near falls and along rim of sandstone canyon; 10/7/94.

Brassicaceae

**Barbarea vulgaris* R.Brown var *arcuata* (Opiz ex J.S. Presl. & C. Presl.) Fries - FR=2; borders of glade on SG1; 4/17/94.
Cardamine concatenata (Michaux) O. Schwarz - FR=3; glade, border of glade; 4/1/94.
C. parviflora L. var. *arenicola* (Britton) O. Schwarz - FR=2; growing among mosses on SG3; 4/8/94.
Draba brachycarpa Nutt ex Torrey & A. Gray - FR=3; glade; 4/15/94.

**Lepedium campestre* (L.) R.Br. - FR=1; border of glade on SG1; 4/24/94.
L. virginicum L. var. *virginicum* - FR=3; border of glade; 5/6/94.

Cactaceae

Opuntia humifusa (Raf.) Raf. var. *humifusa* - FR=2; glade; 5/6/94.

Caesalpiniaceae

Cercis canadensis L. - FR=2; border of glade near falls and along rim of sandstone canyon on SG1; 9/28/94.
Chamaecrista fasciculata (Michaux) E. Greene - FR=2; border of glade on SG1; 7/22/94.

Callitrichaceae

Callitriche heterophylla Pursh var. *heterophylla* - FR=1; 2 plants found in persistent pool on SG1; 5/13/94.

Campanulaceae

Lobelia spicata Lam. - FR=1; moist spots on SG1; 6/12/94.
Triodanis perfoliata (L.) Niewl. f. *perfoliata* - FR=1; moist spots on SG1; 5/13/94.

Caprifoliaceae

Lonicera flava Sims - FR=1; climbing on *Prunus mexicana* near falls on SG1; 4/29/94.
Symphoricarpos orbiculatus Moench - FR=1; border of glade near falls on SG1; 10/7/94.
Viburnum rufidulum Raf. - FR=1; growing on edge of falls; 5/13/94.

Caryophyllaceae

**Arenaria serpyllifolia* L. - FR=2; glade and border of glade; 4/24/94.
**Cerastium brachypetalum* Pers. - FR=1; growing under Juniperus virginiana on SG1; 4/24/94.
**C. fontanum* Baumg. - FR=1; border of glade on SG1; 4/24/94.
**Dianthus armeria* L. - FR=3; glade, border of glade; 6/18/94.
Paronychia fastigiata (Raf.) Fern. var *paleacea* Fern - FR=1; border of glade in shade; 7/9/94.
Silene regia Sims - FR=1; two plants along southeastern border of SG1 growing beside *Juniperus virginiana*; 9/3/94.

Clusiaceae

Hypericum gentianoides (L.) Britton - FR=2; glade; 7/9/94.
H. punctatum Lam. - FR=2; border of SG1 in moist soil; 6/12/94.

Cornaceae

Cornus amomum Miller ssp. *obliqua* (Raf.) J. Wilson - FR=1; gravel bar on western most border of SG1; 5/30/94.
C. florida L. - FR=1; edge of falls; 9/30/94.

Ebenaceae

Diospyros virginiana L. var. *platycarpa* Sarg. f. *platycarpa* - FR=1; near falls on rim of sandstone canyon; 10/7/94.

Ericaceae

Vaccinium arboreum Marshall - FR=3; glade, border of glade; 9/18/94.

Euphorbiaceae

Acalypha gracilens A. Gray - FR=1; glade on SG1; 8/6/94.
Chamaesyce maculata (L.) Small - FR=1; gravelly soil on SG1; 7/30/94.
C. nutans (Lag.) Small - FR=1; gravelly soil on SG1; 7/30/94.
Croton capitatus Michaux var. *captitatus* - FR=3; glade; 7/16/94.
Crotonopsis elliptica Willd. - FR=4; glade; 7/30/94.
Euphorbia corollata L. - FR=2; glade, border of glade; 7/30/94.
E. dentata Michaux - FR=1; border of glade on SG1; 8/6/94.
Tragia betonicifolia Nutt. - FR=2; glade on SG1; 6/4/94.

Fabaceae

Baptisia alba (L.) Vent. - FR=1; border of SG1; 5/8/94.
B. bracteata Muhlenb. ex Elliot - FR=1; border of SG1 & SG3; 5/8/94.
Lespedeza repens (L.) Barton - FR=1; border of glade; 9/23/94.
Stylosanthes biflora (L.) Britton, Stearns & Pogg - FR=2; border of glade; 6/4/94.
Tephrosia virginiana (L.) Pers. - FR=2; border of glade; 6/12/94.
Trifolium reflexum L. var. *reflexum* - FR=1; border of glade; 5/23/94.

Fagaceae

Quercus alba L. - FR=2; border of glade, and along rim of sandstone canyon on SG1; 9/23/94.
Q. marilandica Muenchh. - FR=2; glade, border of glade; 6/18/94.
Q. stellata Wangenh. var. stellata - FR=2; glade, border of glade; 6/12/94.
Q. velutina Lam. f. velutina - FR=1; border of glade; 10/7/04.

Gentianaceae

Gentiana puberulenta J. Pringle - FR=1; border of glade, rocky fragmented soil on glade; 9/29/94.
Sabatia angularis (L.) Pursh
f. *albiflora* House - FR=1; border of glade on SG1; 8/6/94.
f. *angularis* - FR=2; border of glade on SG1; 7/9/94.

Juglandaceae

Carya texana Buckley - FR=1; glade, border of glade; 9/29/94.

Lamiaceae

Monarda bradburniana Beck - FR=3; border of glade; 5/23/94.
M. fistulosa L. ssp. *fistulosa* - FR=3; border of glade; 6/12/94.
Pycnanthemum tenuifolium Scrader - FR=2; border of glade; 8/6/94.

Linaceae

Linum medium (Planchon) Britton var. *texanum* - FR=3; glade; 6/18/94.

Lythraceae

Cuphea viscosissima Jacq. - FR=2; in seep on SG1 & SG2; 8/6/94.

Lythrum alatum Pursh var. *alatum* - FR=2; in seep on SG1; 6/18/94.
Rotala ramosior (L.) Koehne - FR=1; in seep on SG1; 7/9/94.

Mimosaceae

Schrankia nuttalli (DC. ex Britton & Rose) Standely - FR=2; border of glade; 6/12/94.

Oleaceae

Fraxinus americana L. - FR=1; glade on SG1 & SG4; 9/29/94.

Onagraceae

Ludwigia alternifolia L. - FR=1; seep on SG1; 7/6/94.
Oenothera linifolia Nutt. - FR=2; glade; 5/13/94.

Oxalidaceae

Oxalis violacea L. - FR=3; glade, border of glade; 4/17/94.

Passifloraceae

Passiflora lutea L. var. *glabriflora* Fern. - FR=1; border of SG1; 7/30/94.

Plantaginaceae

Plantago aristata Michaux - FR=3; glade, border of glade; 6/18/94.
**P. lanceolata* L. - Fr=2; border of glade on SG1; 6/4/94.
P. pusilla Nutt. var. *pusilla* - FR=3; glade on SG1, SG2 & SG3; 6/4/94.
P. virginica L. - FR=2; glade on SG1 & SG3; 5/8/94.

Platanaceae

Platanus occidentalis L. - FR=1; edge of falls and rim of sandstone canyon on SG1; 9/23/94.

Polemoniaceae

Phlox pilosa L. ssp. *ozarkana* (Wherry) Wherry - FR=3; border of glade on SG1, grassy area of glade on SG2; 4/22/94.

Polygalacaee

Polygala sanguinea L. f. *sanguinea* - FR=2; glade on SG1; 6/18/94.
P. verticillata L. - FR=1; glade on SG1; 9/9/94.

Polygonaceae

Polygonum tenue Michaux - FR=3; glade on SG1; 8/21/94.
**Rumex acetosella* L. - FR=3; glade on SG1; 5/6/94.

Portulacaceae

Portulaca oleracea L. - FR=2; seep on SG1; 7/22/94.
Talinum calycinum Engelm. - FR=3; glade; 5/23/94.

Primulaceae

Dodecatheon meadia L. var. *brachycarpum* (Small) Fasset f. *brachycarpum* - FR=1; seep on northeastern border of SG1; 4/22/94.

Ranunculaceae

Anemonella thalictroides (L.) Spach. f. *thalictroides* - FR=3; glade; 4/8/94.
Delphinium carolinianum Walter ssp. *carolinianum* - FR=3; moist sites on northern border of SG1; 5/28/94.
Ranunculus fascicularis Muhlenb. ex. Bigelow - FR=2; seep & moist ground on SG1; 4/1/94.
R. harveyi (A. Gray) Britton f. harveyi - FR=2; seep & moist ground on SG1; 4/1/94.

Rhamnaceae

Rhamnus caroliniana Walter - FR=1; border of glade on SG3 & SG4; 10/23/94.

Rosaceae

Physocarpus opulifolius (L.) Maxim var. *intermedius* (Rydb.) Robinson - FR=2; gravel bar and stream bank on SG1; 5/13/94.
Prunus hortulana L. - FR=1; border of glade; 10/7/94.
P. mexicana S. Watson - FR=1; border of glade near falls on SG1; 10/7/94.
Rosa carolina L. - FR=1; border of glade on SG1; 7/3/94.
R. setigera Michaux var. *tomentosa* Torrey & A. Gray f. *tomentosa* - FR=1; edge of falls on SG1; 7/23/94.
R. setigera Michaux var. *setigera* f. *setigera* - FR=1; border of glade on SG1; 7/3/94.
Rubus flagellaris Willd. - FR=1; border of glade near falls on SG1; 5/13/94.
R. invisus (L. Baily) Britton - FR=1; border of glade near falls on SG1; 6/29/94.

Rubiaceae

Cephalanthus occidentalis L. - FR=2; edge of falls, stream banks and gravel bar on SG1; 7/9/94.
Diodia teres Walter - FR=4; glade, border of glade; 7/16/94.
Galium obtusum Bigelow ssp. *obtusum* - FR=1; border of glade near falls on SG1; 7/30/94.
Hedyotis crassifolia Raf. - FR=4; glade; 4/8/94.

Salicaceae

Salix caroliniana Michuax - FR=2; gravel bar on SG1; 4/24/94.

Sapotaceae

Bumelia lanuginosa (Michaux) Pers. - FR=1; edge of falls on SG1; 10/7/94.

Saxifragaceae

Heuchera x hirsuticaulis (Wheelock) Rydb. - FR=1; border of glade in moist site; 5/13/94. Note: the nomenclature here follows Gleason & Cronquist (1991) rather than Yatskievych and Turner (1990) because the characters of this specimen were more in line with the treatment in Gleason and Cronquist.

Schrophulariaceae

Agalinis tenuifolia (M.Vahl) Raf. - FR=3; border of glade on SG1; 9/3/94.
Gratiola neglecta Torrey - FR=1; seep on SG1; 5/13/94.
Leucospora multifida (Michaux) Nutt. - FR=3; moist spots on SG1 & SG3; 7/9/94.
Nuttallanthus canadensis (L.) D. Sutton - FR=2; glade on SG1; 5/13/94.
Penstemon pallidus Small - FR=2; glade; 4/29/94.
**Veronica* arvensis L. - FR=3; border of glade on SG1; 5/6/94.

Solanaceae

Solanum carolinense L. var. *carolinense* - FR=3; glade on SG1; 6/4/94.

Ulmaceae

Celtis tenuifolia Nutt. var. *tenuifolia* - FR=1; glade on SG1; 6/18/94.
Ulmus rubra Muhlenb. FR=1; glade on SG1; 9/23/94.

Verbenaceae

Glandularia canadensis (L.) Nutt. - FR=1; border of glade on SG1; 4/24/94.

Violaceae

Viola pedata L. f. *pedata* - border of glade on SG3; 4/1/94.
V. rafinesquii Greene - FR=3; glade and border of glade; 4/8/94.
V. sororia Willd. f. *sororia* - FR=3; border of glade on SG1; 4/17/94.

Vitaceae

Vitis aestivalis Michaux - FR=1; border of glade near falls on SG1; 10/7/94.

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Commelinaceae

Tradescantia ohiensis Raf. - FR=2; glade; 5/28/94.

Cyperaceae

Bulbostylis capillaris (L.) C.B. Clarke - FR=2; moist spots on SG1; 7/22/94.
Carex brevior (Dewey) Mackenzie ex Lunell - FR=1; border of glade near falls on SG1; 5/30/94.
C. bushii Mackenzie - FR=2; border of glade; 5/8/94.
C. cephalophora Willd. - FR=1; border of glade on SG1; 6/4/94.
C. complanata Torrey & Hook. var. hirsuta (L. Baily) Gleason - FR=2; border of glade on SG1; 5/28/94.
C. flaccosperma Dewey var. glaucodea (Tuckerman) Kük - FR=1; moist, shady spots of glade on SG1; 5/13/94.
C. frankii Kunth - FR=1; muddy bank of intermittent stream on SG1; 5/30/94.
C. gravida L. Baily - FR=1; muddy bank of pool on SG1; 5/23/94.
C. meadii Dewey - FR=1; seep on SG1; 4/29/94.
C. vulpinoidea Michaux - FR=1; beside pool on SG1; 5/30/94.
Cyperus acuminatus Torrey & Hook. - FR= 2; seep on SG1; 8/21/94.
C. aristatus Rottb. - FR=3; seep on SG1; 7/22/94.
Elocharis compressa Sullivant - FR=3; seep on SG1; 5/28/94.

E. obtusa (Willd.) Schultes var. *obtusa* - FR=3; growing near water in mud along stream bank on SG1; 6/18/94.
Fimbristylis autumnalis (L.) Roemer & Schultes - FR=2; seep on SG1; 8/21/94.
F. puberula (Michaux) M. Vahl var. *puberula* - FR=3; 5/28/94.
Lipocarpha micrantha (M. Vahl) G. Tucker - FR=2; seep on SG1; 7/9/94.
Rhynchospora globularis (Chapman) Small var. *recognita* Gale - FR=1; above stream bank on SG1; 6/29/94.
Scirpus pendulas Muhlenb. ex Elliot - FR=3; seep on SG1; 5/28/94.

Iridaceae

Sisyrinchium campestre E. Bickn. f. *campestre* - FR=3; seep & glade on SG1, glade on SG2-4; 4/15/94.

Juncaceae

Juncus brachycarpus Engelm. - FR=1; seep on SG1; 6/29/94.
J. interior Wieg. - FR=1; seep on SG1; 6/29/94.
J. torreyi Cov. - FR=1; seep on SG1; 7/9/94.
Luzula bulbosa (Alph. Wood) Rydb. - FR=3; seep & glade on SG1, glade on SG2-4; 4/29/94.

Liliaceae

Allium canadense L.
var. *canadense* - FR=4; glade; 5/30/94.
var. *mobilense* (Regal) F. Ownbey - FR=4; glade; 5/23/94.
Camassia scilloides (Raf.) Cory f. scilloides - FR=3; glade, border of glade; 4/24/94.
Hypoxis hirsuta (L.) Cov. f. villosissima - FR=3; glade, especially wet places; 4/15/94.
Nothoscordum bivalve (L.) Britton - FR=4; glade; 4/1/94.

Orchidaceae

Spiranthes tuberosa Raf. - FR=1; border of glade on SG1; 8/12/94.
S. vernalis Engelm & A. Gray - FR=3; glade on SG1; 9/9/94.

Poaceae

Agrostis elliottiana Schultes - FR=3; glade; 5/23/94.
A. hyemalis (Walter) Britton, Sterns & Pogg var. *hyemalis* - FR=2; glade on SG1; 6/12/94.
A. perennans (Walter) Tuckerman - FR=1; growing in fissure on SG4; 9/3/94.
Alopecurus carolinianus Walter - FR=2; seep on SG1; 5/23/94.
Andropogon gerardii Vitman var. *gerardii* - FR=3; glade; 8/6/94.
Aristida dichotoma Michaux var. dichotoma - FR=2; rocky, fragmented soil on SG2; 10/23/94.
A. longespica Poiret var. *longespica* - FR=3; glade; 9/3/94.
A. purpurascens Poiret - FR=3; sandy soil on SG1; 9/23/94.
Chasmanthium latifolium (Michaux) Yates - FR=4; moist spots on glade on SG1; 7/30/94.
**Dactylis glomerata* L. - FR=2; glade on SG1; 6/4/94.
Danthonia spicata (L.) P. Beauv. ex Roemer & Schultes var. *spicata* - FR=3; 5/30/94.
Dichanthelium acuminatum (Sw.) Gould & C. A. Clark var. *acuminatum* - FR=2; glade on SG1; 6/4/94.
Digitaria cognata (Schultes) Pilger var. *cognata* - FR=1; glade on SG1; 9/9/94.
Elymus canadensis L. - FR=2; glade and border of glade on SG1; 6/29/94.
**Festuca pratensis* Hudson - FR=2; glade and border of glade on SG1; 6/4/94.
Leersia oryzoides (L.) Sw. - FR=1; growing at edge of pool in very shallow water on SG1; 9/18/94.
L. virginica Willd. - FR=1; growing in shallow pool on SG4; 9/3/94.
Melica nitens (Scibner) Nutt. - FR=3; border of glade on SG1; 5/23/94.

Panicum depauperatum Muhlenb. - FR=2; glade on SG1; 6/29/94.
P. flexile (Gattinger) Scribner - FR=2; glade; 10/7/94.
P. philadelphicum Trin. var. *philadelphicum* - FR=3; seep on SG1; 8/17/94.
P. virgatum L. - FR=4; glade and seeps; 7/16/94.
**Poa palustris* L. - FR=2; border of SG1; 5/28/94.
Schizachyrium scoparium (Michaux) Nash - FR=3; glade; 9/9/94.
Sphenopholis obtusata (Michaux) Scribner var. *obtusata* - FR=3; glade on SG1; 6/4/95.
Sporobolus asper (Michaux) Kunth var. *asper* - FR=3; glade, border of glade; 9/30/94.
S. clandestinus (Biehler) A. Hitch. - FR=2; glade; 9/9/94.
S. ozarkanus Fern. - FR=3; glade; 9/23/94.
S. vaginiflorus (Torrey) Alph. Wood - FR=3; rocky, fragmented soil on SG4; 10/23/94.
Tridens flavus (L.) A. Hitch. var. *flavus* - FR=3; glade, border of glade; 10/23/94.
Vulpia octoflora (Walter) Rydb. var. *glauca* (Nutt.) Fern. - FR=3; glade; 5/23/94.

Table 23. New plant taxa for Pulaski Co. and dates specimens were collected from FLW during 1994.

Alopecurus carolinianus Walter - 5/23/94
Aristida longespica Poiret var. *longespica* - 9/3/94
Aristida purpurascens Poiret - 9/23/94
Aster oolentangiensis Riddell var. *oolentangiensis* - 9/29/94
Aster laevis L. - 10/14/94
Bulbostylis capillaris (L.) C.B. Clarke - 7/22/94
Cacalia plantaginea (Raf.) Shinners - 6/18/94
Carex gravida L. Baily - 5/23/94
Carex vulpinoidea Michaux - 5/30/94
Carex brevior (Dew) Mackenzie - 5/30/94
Cuscuta pentagona Engelm. - 6/29/94
Cystopteris tennesseensis Shaver - 7/16/94
Digitaria cognata (Schultes) Pilger var. *cognata* - 9/9/94
Diospyrus virginiana L. var. *platycarpa* Sarg. f. platycarpa - 10/7/94
Equisetum hymale L. var. *affine* (Engelm.) A. A. Eaton - 7/16/94
Erigeron strigosus Muhlenb. ex Willd. var. *beyrichii* - 6/18/94
Galium obtusum Bigelow ssp. *obtusum* - 7/30/94
Galium circaezans Michaux var. *circaezans* - 6/12/94
Geum vernum (Raf.) Torrey & A. Gray - 5/8/94
Gratiola neglecta Torrey - 5/13/94
Heliopsis helianthoides (L.) Sweet var. *occidentalis* (T. Fisher) Steyerm. - 8/21/94
Leersia oryzoides (L.) Sw. - 9/18/94
Lindera benzoin (L.) Blume var. *pubescens* (Palmer & Steyerm.) Rehder - 10/7/94
Nuttallanthus canadensis (L.) D. Sutton - 5/13/94
Opuntia humifusa (Raf.) Raf. var. *humifusa* - 5/6/94
Panicum philadelphicum Trin. var. *philadelphicum* - 8/17/94
Paronychia fastigiata (Raf.) var. *paleacea* Fern. - 7/9/94
Phlox pilosa L. ssp. *ozarkana* (Wherry) Wherry - 4/22/94
Prunus hortulana L. - 10/7/94
Rhynchospora globularis (Chapman) Small var. *recognita* Gale - 6/29/94
Rubus invisus (L. Baily) Britton - 6/29/94
Sabatia angularis (L.) Pursh var. *albiflora* House - 8/5/94
Scirpus pendulus Muhlenb. ex Elliot - 5/28/94
Spiranthes tuberosa Raf. - 8/5/94
Sporobolus asper (Michaux) Kunth var. *asper* - 9/30/94
Sporobolus vaginiflorus (Torrey) Alph. Wood - 10/23/94
Sporobolus ozarkanus Fern. - 9/23/94
Strophostyles helvola (L.) Elliott var. *helvola* - 8/3/94

Source: Hays 1996.

Table 24. Federally and state-listed plants surveyed for on FLW, Pulaski Co., MO, during 1994, and survey results.

Scientific Name	Common Name	Federal	State	Observed on Fort Wood
Agalinis purpurea	Purple false foxglove	WL		
Agalinis skinneriana	A false foxglove	C2	WL	
Agrimonia gryposepala	Tall agrimony	SU		
Alopecurus aequalis	Floating foxtail		R	
Armoracia lacustris	Lake cress	3C	SU	
Aster furcatus	Forked aster	C2	WL	
Aster macrophyllus	Big-leaved aster		E	
Berberis canadensis	American barberry		R	
Bromus latiglumis	Brome grass	SU		
Calamagrostis porteri spp. *insperata*	Reed bent grass	C2	R	
Carex alata	Broadwing sedge		WL	
Carex buxbaumii	Brown bog sedge		R	
Carex comosa	Bristly sedge		R	
Carex conoidea	Field sedge		E	
Carex fissa var. *fissa*	A sedge	C2	SU	
Carex laevivaginata	Smooth-sheath sedge		R	
Carex straminea	Straw sedge		SU	
Carex stricta	Tussock sedge		R	
Carex triangularis	Triangular sedge		E	
Carex trichocarpa	Hairy-fruited sedge		R	
Carex virescens	Ribbed sedge	WL		
Clematis viorna	A leather flower		E	
Crotonopsis linearis	Narrowleaf rushfoil		SU	
Cypripedium reginae	Showy lady's slipper		WL	
Desmodium viridiflorum	Velvety tick trefoil		E	
Dichanthelium leibergii	Panic grass		SU	
Dryopteris carthusiana	Spinulose shield fern		E	
Dryopteris goldiana	Goldie's fern		R	
Elatine triandra	Waterwort		E	
Glyceria acutiflora	Sharp-scaled manna grass	R		
Heuchera parviflora var. *parviflora*	Little leaved alum root		E	
Juglans cinerea	Butternut	C2	WL	X
Malaxis unifolia	Green adder's mouth		SU	
Matelea baldwyniana	Baldwin's milkvine	C2	SU	
Najas gracillima	Thread-like naiad		E	
Nemastylis nuttallii	Celestial lily		SU	
Plantago cordata	Heart-leaved plantain	3C	WL	
Potamogeton pusillus var. *pusillus*	Slender pondweed		E	
Scirpus torreyi	Torrey's bulrush		E	
Scleria ciliata var. *ciliata*	Hairy nut-rush	SU		
Sedum ternatum	Wood stonecrop		WL	
Silene regia	Royal catchfly	3C	WL	X
Sisyrinchium atlanticum	Eastern blue-eyed grass		R	
Smallanthus uvedalius	Yellow-flowered leafcup	WL		
Spiranthes lacera var. *gracilis*	Slender ladies' tresses	WL		
Spiranthes lucida	Shining ladies' tresses		R	

Spiranthes ovalis var. *erostellata*	Oval ladies' tresses		R	
Sporobolus ozarkanus	Bald grass	3C	SU	X
Torreyochloa pallida	Pale manna grass		E	
Trifolium reflexum var. *reflexum*	Buffalo clover		SU	X
Trifolium stolonifera	Running buffalo clover	E	E	
Triosteum angustifolium var. *earnesii*	Yellow-flowered horse gentian		EXT	
Waldsteinia fragarioides ssp. *fragarioides*	Barren strawberry		R	
Zigadenus elegans	White camus		R	

Table 25. Federally and state-listed plants found on FLW, Pulaski Co., between April 1994 and October 1995.

SCIENTIFIC NAME	COMMON NAME	STATUS FED. STATE	T	R	S	DATE OBS.	COMMENTS
Juglans cinerea	Butternut	C2 Watch List	35N	11W	07	05/23/94	South bluffs along Roubidoux Creek
Juglans cinerea	Butternut	C2 Watch List	35N	11W	05	02/10/95	West of Cedar Hill Cemetery; thirteen trees, all diseased
Juglans cinerea	Butternut	C2 Watch List	35N	11W	1617	02/10/95	Ballard Hollow; six trees, all diseased (population extends through two sections)
Juglans cinerea	Butternut	C2 Watch List	35N	10W	2829	02/16/95	Wildcat Shoal Drainage; nineteen trees, all diseased (population extends through two sections)
Juglans cinerea	Butternut	C2 Watch List	34N	11W	2930	03/09/95	Turnbull Hollow; twenty-one trees; all diseased
Juglans cinerea	Butternut	C2 Watch List	34N	12W	12	03/17/95	Roubidoux Tributary; one tree with disease
Juglans cinerea	Butternut	C2 Watch List	34N	12W	03	03/17/95	Roubidoux Creek; two trees, both diseased
Juglans cinerea	Butternut	C2 Watch List	34N	12W	03	03/22/95	Hurd Hollow; twelve trees, all diseased
Juglans cinerea	Butternut	C2 Watch List	35N	11W	05	03/30/95	Tunnel Hollow; eighteen trees, all diseased
Juglans cinerea	Butternut	C2 Watch List	34N	11W	2324	04/02/95	Falls Hollow; ten trees, all diseased
Silene regia	Royal catchfly	3C Watch List	34N	11W	22	09/03/94	Falls Hollow glades; two plants
Silene regia	Royal catchfly	3C Watch List	35N	11W	06	09/03/94	Cedar Hill glade above Roubidoux Ck; 1 plant
Trifolium reflexum var. *reflexum*	Buffalo clover	-- Status Und.	34N	11W	22	05/23/94	Falls Hollow glades; 2 plants
Trifolium reflexum var. *reflexum*	Buffalo clover	-- Status Und.	35N	11W	05 06 07	05/24/94	Roubidoux Creek upland; eight plants scattered along each side of road
Sporobolus ozarkanus	Bald grass	3C Status Und.	34N	11W	22	09/23/94	Falls Hollow glades; approximately 25 plants

Note: C2 status is no longer used by USFWS.

Table 26. Potential ecological landtypes occurring on FLW.

ELT No.	ELT-Landform	Natural Community* (State Rank)[1]	Aspect	Pct. Slope	Soil Series
1	Low flood plain	Wet-mesic bottomland forest (S2) Gravel wash (S3)	Neutral	0-4	Loamy alluvial, Mixed alluvial
2	High flood plain and low terrace	Forested fen (S1)	Neutral	0-4	Hartville
3	High flood plain and low terrace	Mesic bottomland forest (S3)	Neutral	0-4	Huntington
4	Upland waterways	Gravel wash (S3)	Neutral	0-4	Cedargap
5	Upland waterways	Dry bottomland forest (NA) [Not mentioned in Nelson (1987)]	Neutral	0-4	Cedargap
6	Upland waterways	Dry-mesic bottomland forest (S3)	Neutral	0-4	Cedargap
7	Toe slope	Mesic forest (S3)	All	0-14	Clairborne, Viraton
8	Narrow ridge	Chert savanna (S1)	Neutral	0-8	Lebanon
9	Narrow ridge	Dry chert forest (S4S5)	Neutral	0-8	Clarksville, Poynor, Doniphan
12	Broad ridge	Chert savanna (S1)	Neutral	0-8	Lebanon
13	Broad ridge	Dry chert forest (S4S5)	Neutral	0-8	Doniphan, Viraton
16	Side slope	Dry chert forest (S4S5)	South, West	8-99	Clarksville, Poynor, Doniphan
18	Side slope	Dry-mesic chert forest (S4S5)	North, East	8-99	Clarksville, Poynor, Doniphan
19	Side slope	Chert savanna (S1)	South, West	8-99	Bardley
20	Side slope	Dry-mesic limestone/dolomite forest (S4S5)	North, East	8-99	Bardley
21	Side slope	Dolomite glade (S3)	All	5-99	Gasconade
22	Side slope	Xeric limestone/dolomite forest (S4S5)	All	5-99	Gasconade
23	Side slope	Dry limestone/dolomite forest (S4S5)	All	5-99	Gasconade

*From Nelson (1987) except where noted.
[1]S1 = critically imperiled in Missouri
S2 = imperiled in the state
S3 = rare or uncommon
S4 = widespread, abundant, and apparently secure, but with cause for long-term concern
S5 = demonstrably widespread, abundant, and secure.

Table 27. ELTs with the greatest percentage of occurrence in the Oak-Hickory Hills and Oak-Hickory Plains LTAs.

ELT No.	Natural Community	Oak-Hickory Hills (L)		Oak-Hickory Plains (L)[1]	
		Rank	% in R-H Unit	Rank	% in R-H Unit
3	Mesic bottomland forest	5	5		
5	Dry bottomland forest	5	5	4	6
8/12	Chert savanna	1	26	1	58
9	Dry chert forest	4	10		
16	Dry chert forest	2	19	2	20
18	Dry-mesic chert forest	3	18	3	13

[1]All other ELTs accounted for 1 percent or less.

Table 28. Wetland types found on FLW, Pulaski Co., MO, 1993–1994.

Wetland Type	Nelson (1987) Equivalent (State Rank)[1]	Percent of All Wetlands	Acreage	Percent Total Wetland Acreage
Bottomland hardwood	Mesic bottomland (S3) Wet bottomland forest (S2)	66.0	1,395.1	90.0
Shallow fresh marsh	Freshwater marsh (S2) Fen (S2) Deep muck fen (S1)	20.0	114.1	7.3
Shrub swamp	Shrub swamp (S2) Pond shrub swamp (S1)	1.3	13.5	0.9
Shrub flat	Shrub swamp (S2)	4.4	11.6	0.7
Wet meadow	Wet prairie (S1) Wet-mesic prairie (S1)	2.2	7.3	0.5
Gravel bar	Gravel wash (S3)	4.4	5.1	0.3
Deep fresh marsh	Pond marsh (S4S5)	1.3	2.7	0.2
Spring-associated wetlands	(Spring--not described in Nelson) Acid seep (S2)	0.4	2.3	0.1
Total		100.0	1,552.0	100.0

[1]S ranks are used by the Missouri Natural Heritage Database.
S1 = critically imperiled in Missouri
S2 = imperiled in the state
S3 = rare or uncommon
S4 = widespread, abundant, and apparently secure, but with cause for long-term concern
S5 = demonstrably widespread, abundant, and secure.

Source: Harland Bartholomew and Associates, Inc. 1995b.

Table 29. Results of butternut survey on FLW, Pulaski Co., January–April 1995.

SITE	TREE	DBH	CANKER LOCATION/TREE DESCRIPTION	DIEBACK*	T/R	S	SUBSTRATE	LOCATION
A	1	7	Cankers on branches	40	T35N R11W	16	Cedargap cherty silt loam	On terrace between road and creek
A	2	9	Cankers on branches	20	T35N R11W	16	Cedargap cherty silt loam	On terrace between road and creek
A	3	8	Tree dead and down		T35N R11W	16	Cedargap cherty silt loam	On terrace between road and creek
B	1	11	Dead limbs; peeling bark; cankers on branches	50	T35N R11W	17	Cedargap cherty silt loam	Just above floodplain; edge of road
C	1	3	Cankers on bole and branches	15	T35N R11W	17	Cedargap cherty silt loam	Just above floodplain; edge of road
C	2	15	Cankers on bole and branches	75	T35N R11W	17	Cedargap cherty silt loam	Just above floodplain along road
C	3	7	Dead branches; no obvious cankers	10	T35N R11W	17	Cedargap cherty silt loam	Just above floodplain along road
D	1	8	Tree unhealthy; a few cankers on upper bole; vine	15	T35N R11W	05	Clarksville-Gepp very cherty silt loam	In hollow along ephemeral drainage
D	2	3	Appears healthy	10	T35N R11W	05	Clarksville-Gepp very cherty silt loam	In hollow along ephemeral drainage
D	3	1	Appears healthy	10	T35N R11W	05	Clarksville-Gepp very cherty silt loam	In hollow along ephemeral drainage
D	4	7	Possible cankers; few filled buds	60	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
D	5	2	Cankers on bole and branches	50	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
D	6	10	Cankers on branches and upper bole	75	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
D	7	10	Cankers on branches and upper bole	50	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
D	8	12	Cankers on branches	30	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
D	9	4	Cankers on bole and branches; dead adventitious shoots	50	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
D	10	7	Cankers on bole and branches	99	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
D	11	11	Cankers on branches	20	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
D	12	6	Tree dead; a few cankers on bole; no branches	100	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
D	13	9	Possible cankers; poor bud formation	40	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
D	14	6	Possible cankers; poor bud formation	60	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	In hollow along ephemeral drainage
E	1	4	Dark areas and peeling bark on bole	30	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	Fifty ft. from creek
E	2	5	Cankers on bole and branches	50	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	Thirty ft. from creek
E	3	3	Cankers on bole and branches	70	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	Twenty ft. from creek
E	4	7	Cankers on bole and branches	30	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	Thirty ft. from creek
E	5	6	Cankers on bole and branches; peeling	50	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	Sixty ft. from creek
E	6	5	Cankers on bole and branches; dead limbs	75	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	One hundred ft. from creek
E	7	6	Large cankers on bole and branches	65	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	One hundred ft. from creek
E	8	7	Large cankers on bole and branches	85	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	Ten ft. from creek
E	9	6	Cankers on bole and branches; dead limbs	50	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	Fifty ft. from creek
E	10	11	Scattered cankers on bole and branches	30	T35N R10W	29	Gepp-Rock outcrop complex; 35-60% slopes	Ten ft. from creek
E	11	11	Cankers on upper bole and branches	40	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	Ten ft. from base of draw
E	12	6	Cankers on bole; branches; exposed roots	90	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	Fifteen ft. from base of draw
E	13	9	Cankers on bole; branches	45	T35N R10W	28	Gepp-Rock outcrop complex; 35-60% slopes	Fifteen ft. from base of draw
F	1	6	Cankers on upper bole; branches; dead limbs	40	T35N R10W	28	Gepp-Bardley-Clarksville very cherty silt loam; 14-35% slopes	Twenty ft. from creek
F	2	0	Four sprouts from dead base; one cankered	90	T35N R10W	28	Gepp-Bardley-Clarksville very cherty silt loam; 14-35% slopes	Twenty ft. ftom creek
F	3	8	Cankers; recently fallen; many shoots	50	T35N R10W	28	Gepp-Bardley-Clarksville very cherty silt loam; 14-35% slopes	Ten ft. from creek
F	4	6	Three trunks; cankers on upper bole and branches	15	T35N R10W	28	Gepp-Bardley-Clarksville very cherty silt loam; 14-35% slopes	Twenty ft. from creek
F	5	7	Cankers on upper bole and branches	25	T35N R10W	28	Gepp-Bardley-Clarksville very cherty silt loam; 14-35% slopes	Five ft. from creek
F	6	7	Cankers on upper bole and branches	20	T35N R10W	28	Gepp-Bardley-Clarksville very cherty silt loam; 14-35% slopes	Five ft. from creek
G	1	10	Cankers on branches	80	T34N R10W	29	Cedargap cherty silt loam; 0-3% slopes	Thirty ft. from creek; floodplain
G	2	8	Cankers on branches and adventitious shoots	90	T34N R10W	29	Cedargap cherty silt loam; 0-3% slopes	Thirty ft. from creek; floodplain
G	3	5	Cankers on branches and adventitious shoots	99	T34N R10W	29	Cedargap cherty silt loam; 0-3% slopes	Twenty ft. from creek; floodplain
G	4	13	Cankers on branches and adventitious shoots	90	T34N R10W	29	Cedargap cherty silt loam; 0-3% slopes	Three ft. from creek; floodplain
G	5	2	Cankers on branches and bole	50	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Fifteen feet from creek; floodplain
G	6	8	Cankers on adventitious shoots on bole	99	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Fifteen ft. from creek; floodplain

SITE	TREE	DBH	CANKER LOCATION/TREE DESCRIPTION	DIEBACK*	T/R	S	SUBSTRATE	LOCATION
G	7	12	Adventitious shoots; cankers on upper branches	70	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Fifteen ft. from creek; floodplain
G	8	4	Adventitious shoots; cankers on upper branches	30	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Thirty ft. from creek; floodplain
G	9	9	Adventitious shoots; cankers on upper bole and branches	70	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Thirty ft. from creek; floodplain
G	10	4	Cankers on branches	40	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Fifteen ft. from creek; floodplain
G	11	3	Cankers on branches	70	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Eighteen ft. from creek; floodplain
G	12	7	Cankers on main branches	40	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Twenty ft. from creek; floodplain
G	13	3	Cankers on bole	30	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Twenty ft. from creek; floodplain
G	14	4	Cankers on bole	20	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Twenty ft. from creek; floodplain
G	15	7	Cankers on branches	80	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Thirty ft. from creek;floodplain
H	1	7	Cankers on branches	50	T34N R10W	39	Cedargap cherty silt loam; 0-3% slopes	Fifteen ft. from creek; rocky slope
H	2	8	Cankers on branches	40	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Twenty ft. from creek; rocky slope
H	3	5	Cankers on bole and branches	40	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Ten ft. from creek; rocky slope
H	4	5	Cankers on bole and branches	70	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Fifteen ft. from creek; rocky slope
H	5	9	Cankers on branches	50	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Fifty ft. from creek; rocky slope
H	6	11	Adventitious shoots from fallen bole; cankers on bole	90	T34N R10W	30	Cedargap cherty silt loam; 0-3% slopes	Sixty ft. from creek; rocky slope
I	0	0	No butternut found		T35N R11W	29;30;19	Cedargap; Clairborne; Clarksville; 0-35% slopes	
J	0	0	No butternut found		T35N R11W	29;30;19	Cedargap; Clairborne; Clarksville; 0-35% slope	
K	0	0	No butternut found		T35N R12W	25	Clarksville-Gepp(14-35%)/Doniphan(3-8%) very cherty silt loams	
L	0	0	No butternut found		T34N R12W	01	Clarksville(9-14%) & Clarksville-Gepp(14-35%) very cherty silt loam	
M	1	10	Large cankers on bole; clear oozing site on bark	50	T34N R12W	03	Nolin silt loam	One hundred ft. from creek; floodplain
M	2	3	Cankers on bole and branches	80	T34N R12W	03	Nolin silt loam	Eighty ft. from creek; floodplain
N	1	9	Cankers on branches	85	T34N R12W	12	Gepp-Bardley-Clarksville very cherty silt loams; 14-35% slopes	Three ft. from creek in hollow
O	1	10	Cankers on bole; peeling bark	70	T34N R12W	03	Gepp-Bardley-Clarksville very cherty silt loams; 14-35% slopes	Two hundred ft. from creek; seepy toeslope
O	2	13	Cankers and stains on branches	50	T34N R12W	03	Gepp-Bardley-Clarksville very cherty silt loams; 14-35% slopes	Two hundred ft. from creek
O	3	7	Cankers on branches	90	T34N R12W	03	Gepp-Bardley-Clarksville very cherty silt loams; 14-35% slopes	Two hundred ft. from creek
O	4	5	Many cankers on bole and branches; bark is oozing clear liquid	70	T34N R12W	034	Gepp-Bardley-Clarksville very cherty silt loams; 14-35% slopes	
O	5	6	Cankers on bole and branches	35	T34N R12W	03	Cedargap cherty silt loam; 0-3% slopes	One hundred thirty ft. from creek
O	6	10	Cankers on bole and branches	60	T34N R12W	03	Cedargap cherty silt loam; 0-3% slopes	One hundred ft. from creek
O	7	12	Cankers on branches	75	T34N R12W	03	Cedargap cherty silt loam; 0-3% slopes	One hundred fifty ft. from creek
O	8	14	Oozing cankers on bole; mites; weevils; flies; etc.	60	T34N R12W	03	Cedargap cherty silt loam; 0-3% slopes	One hundred fifty ft. from creek
O	9	17	Cankers on branches	60	T34N R12W	03	Gepp-Bardley-Clarksville very cherty silt loam; 14-35% slopes	One hundred fifty ft. from creek
O	10	8	Cankers on bole and branches	98	T34N R12W	03	Gepp-Bardley-Clarksville very cherty silt loam; 14-35% slopes	One hundred fifty ft. from creek
O	11	9	Cankers on bole and branches; adventitious shoots on bole	99	T34N R12W	03	Gepp-Bardley-Clarksville very cherty silt loam; 14-35% slopes	Two hundred ft. from creek
O	12	12	Cankers on bole and branches	90	T34N R12W	03	Gepp-Bardley-Clarksville very cherty silt loam; 14-35% slopes	Two hundred ft. from creek
P	0		No butternut found		T34N R12W	21	Poynor very cherty silt loam; 14-35% slopes	
P	0		No butternut found		T34N R12W	22	Poynor very cherty silt loam; 14-35% slopes	
P	0		No butternut found		T34N R12W	23	Clarksville-Gepp very cherty silt loams; 14-35% slopes	
Q	0		No butternut found		T34N R12W	34	Cedargap silt loam; 0-3% slopes	
R	0		No butternut found		T35N R10W	31	Clarksville-Gepp very cherty silt loams; 14-35% slopes	
R	0		No butternut found		T35N R11W	36	Clarksville-Gepp very cherty silt loams; 14-35% slopes	
S	0		No butternut found		T35N R11W	25	Cedargap cherty silt loam; 0-3% slopes	
S	0		No butternut found		T35N R11W	25	Clarksville-Gepp very cherty silt loams; 14-35% slopes	Zero ft. from creek
T	1	10	Cankers and peeling bark on branches	40	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	2	7	Cankers on bole and branches	60	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	3	7	Cankers on bole and branches	90	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	4	6	Cankers on bole and branches	60	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	5	20	Dead limbs	85	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	

SITE	TREE	DBH	CANKER LOCATION/TREE DESCRIPTION	DIEBACK*	T/R	S	SUBSTRATE	LOCATION
T	6	10	Cankers on bole and branches	50	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	7	7	Cankers on hyphal pegs on branches	50	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	8	2	Cankers on bole and branches	90	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	9	4	Cankers on bole and branches	40	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	10	8	Cankers on bole and branches	85	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	11	15.	Cankers on bole and branches	60	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	12	10	Cankers on bole and branches	40	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	
T	13	9	Cankers on bole and branches; hyphal pegs	50	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	14	6	Cankers on bole and branches	40	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	15	11	Cankers on bole and branches	60	T35N R11W	05	Clarksville-Gepp very cherty silt loams; 14-35% slopes	
T	16	2	Cankers on bole and branches	25	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	17	3	Peeling bark; dead limbs	50	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
T	18	1	Cankers on bole and branches; peeling bark	10	T35N R11W	05	Cedargap cherty silt loam; 0-3% slopes	
U	0		No butternut found		T34N R11W	02	Cedargap cherty silt loam; 0-3% slopes	
U	0		No butternut found		T34N R11W	10	Cedargap cherty silt loam; 0-3% slopes	One hundred ft. from creek
V	1	17	Stains; peeling bark	50	T34N R11W	23	Cedargap cherty silt loam; 0-3% slopes	
V	2	2	Dead limbs	80	T34N R11W	23	Cedargap cherty silt loam; 0-3% slopes	
V	3	4	Cankers on branches	75	T34N R11W	23	Clarksville-Gepp very cherty silt loams; 14-35% slopes	
V	4	12	Cankers on branches; peeling bark	70	T34N R11W	23	Clarksville-Gepp very cherty silt loams; 14-35% slopes	
V	5	5	Cankers on bole and branches	80	T34N R11W	23	Cedargap cherty silt loam; 0-3% slopes	
V	6	3	Cankers on bole and branches	90	T34N R11W	23	Cedargap cherty silt loam; 0-3% slopes	
V	7	7	Cankers on bole and branches	80	T34N R11W	23	Cedargap cherty silt loam; 0-3% slopes	
V	8	5	Cankers on bole and branches	85	T34N R11W	23	Cedargap cherty silt loam; 0-3% slopes	
V	9	4	Cankers on bole and branches	95	T34N R11W	23	Cedargap cherty silt loam; 0-3% slopes	
V	10	7	Cankers on bole and branches	60	T34N R11W	23	Cedargap cherty silt loam; 0-3% slopes	

*Percent canopy dieback.
Site Locations:
A Ballard Hollow
B Cedar Hill Cemetary
C Cedar Hill Cemetary
D Cedar Hill Cemetary
E Wildcat Shoal Drainage; north facing slope
F Wildcat Shoal Drainage; south facing slope
G Turnbull Hollow; north and east banks
H Turnbull Hollow; south and west banks
I Smith Branch; east bank
J Smith Branch; west bank
K Unnamed drainage
L Penns Pond tributary to Hurd Hollow
M Roubidoux Creek
N Roubidoux Creek tributary
O Hurd Hollow
P Mush Paddle Hollow
Q Macedonia Cemetary creek
R Big Piney River quarry drainage
S Big Piney River; east drainage near Stone Mill Spring parking lot
T Tunnel Hollow
U Falls Hollow

5 Summary

Twenty-four species of conservation concern, representing 50 occurrences, were located on FLW during this study. No Federally Endangered or Threatened species was found on FLW during this survey. However, 7 Missouri-Rare species, 6 Missouri-Status Undetermined species, 10 Missouri-Watch List species, and 1 Missouri-Extirpated species (observed during migration) were located on FLW.

Of the 24 listed species identified on FLW, 5 species of birds were observed only during fall or spring migration and do not appear to have a reproducing population on FLW. One listed species of freshwater mussel was not found living within the boundaries of FLW; however, live specimens were found several miles downstream. Thus a total of 18 reproducing populations of listed species of plants or animals were discovered.

Surveys for common species of freshwater mussels, fish, amphibians, reptiles, and birds produced species lists for all groups that are consistent with what is expected to occur in the Upper Ozarks. This result indicates that species biodiversity (based upon species presence) on FLW is relatively intact.

Surveys of natural communities indicate that few high quality natural communities exist on FLW. Very few areas remain that were not negatively impacted by past land use. The floral study of Falls Hollow sandstone glades found many weedy, non-native plants, interspersed with conservative glade plant species. Many of the existing natural communities have become overgrown and do not represent high quality natural communities. Management strategies emphasizing landtype associations (i.e., bottomland forests, savanna, upland forests) were developed to enhance the natural communities associated with these landtype associations.

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Appendix: Common and Scientific Names for Flora and Fauna Referred to in This Report

Common Name (Animals)	Scientific Name	Category
Acadian flycatcher	*Empidonax virescens*	Bird
Alder flycatcher	*Empidonax alnorum*	Bird
American burying beetle	*Nicrophorus americanus*	Insect
American coot	*Fulica americana*	Bird
American crow	*Corvus brachyrhynchos*	Bird
American eel	*Anguilla rostrata*	Fish
American goldfinch	*Carduelis tristis*	Bird
American kestrel	*Falco sparverius*	Bird
American redstart	*Setophaga ruticilla*	Bird
American robin	*Turdus migratorius*	Bird
American tree sparrow	*Spizella arborea*	Bird
American wigeon	*Anas americana*	Bird
American woodcock	*Scolopax minor*	Bird
Asiatic clam	*Corbicula fluminea*	Mussel
Bachman's sparrow	*Aimophila aestivalis*	Bird
Bald eagle	*Haliaeetus leucocephalus*	Bird
Baltimore oriole	*Icterus galbula*	Bird
Banded darter	*Etheostoma zonale*	Fish
Banded sculpin	*Cottus carolinae*	Fish
Barn owl	*Tyto alba*	Bird
Barn swallow	*Hirundo rustica*	Bird
Barred owl	*Strix varia*	Bird
Bay-breasted warbler	*Dendroica castanea*	Bird
Beaver	*Castor canadensis*	Mammal
Bell's vireo	*Vireo bellii*	Bird
Belted kingfisher	*Ceryle alcyon*	Bird
Bewick's wren	*Thryomanes bewickii*	Bird
Big brown bat	*Eptesicus fuscus*	Mammal
Bigeye shiner	*Notropis boops*	Fish
Bison	*Bison bison*	Mammal
Black bear	*Ursus americanus*	Mammal
Black bullhead	*Ameiurus melas*	Fish

Common Name (Animals)	Scientific Name	Category
Black crappie	*Pomoxis nigromaculatus*	Fish
Black rat snake	*Elaphe obsoleta obsoleta*	Reptile
Black redhorse	*Moxostoma duquesnei*	Fish
Black sandshell	*Ligumia recta*	Mussel
Black-and-white warbler	*Mniotilta varia*	Bird
Black-billed cuckoo	*Coccyzus erythropthalmus*	Bird
Blackburnian warbler	*Dendroica fusca*	Bird
Black-capped chickadee	*Parus atricapillus*	Bird
Black-crowned night heron	*Nycticorax nycticorax*	Bird
Blacknose shiner	*Notropis heterolepis*	Fish
Blackpoll warbler	*Dendroica striata*	Bird
Blackspotted topminnow	*Fundulus olivaceus*	Fish
Black-throated green warbler	*Dendroica virens*	Bird
Blanchard's cricket frog	*Acris crepitans blanchardi*	Amphibian
Bleeding shiner	*Luxilus zonatus*	Fish
Blue grosbeak	*Guiraca caerulea*	Bird
Blue jay	*Cyanocitta cristata*	Bird
Bluegill	*Lepomis macrochirus*	Fish
Blue-gray gnatcatcher	*Polioptila caerulea*	Bird
Bluestripe darter	*Percina cymatotaenia*	Fish
Blue-winged teal	*Anas discors*	Bird
Blue-winged warbler	*Vermivora pinus*	Bird
Bluntnose minnow	*Pimephales notatus*	Fish
Bobolink	*Dolichonyx oryzivorus*	Bird
Broadhead skink	*Eumeces laticeps*	Reptile
Broad-winged hawk	*Buteo platypterus*	Bird
Brook silverside	*Labidesthes sicculus*	Fish
Brown creeper	*Certhia americana*	Bird
Brown thrasher	*Toxostoma rufum*	Bird
Brown-headed cowbird	*Molothrus ater*	Bird
Bufflehead	*Bucephala albeola*	Bird
Bull frog	*Rana catesbeiana*	Amphibian

Common Name (Animals)	Scientific Name	Category
Bullsnake	*Pituophis melanoleucus sayi*	Reptile
Canada goose	*Branta canadensis*	Bird
Canada warbler	*Wilsonia canadensis*	Bird
Canvasback	*Aythya valisineria*	Bird
Carolina chickadee	*Parus carolinensis*	Bird
Carolina wren	*Thryothorus ludovicianus*	Bird
Caspian tern	*Sterna caspia*	Bird
Cattle egret	*Bubulcus ibis*	Bird
Cave salamander	*Eurycea lucifuga*	Amphibian
Cedar waxwing	*Bombycilla cedrorum*	Bird
Central Missouri cave amphipod	*Allocrangonyx hubrichti*	Crustacean
Central newt	*Notophthalamus viridescens louisianensis*	Amphibian
Central stoneroller	*Campostoma anomalum*	Fish
Cerulean warbler	*Dendroica cerulea*	Bird
Channel catfish	*Ictalurus punctatus*	Fish
Chestnut lamprey	*Ichthyomyzon castaneus*	Fish
Chestnut-sided warbler	*Dendroica pensylvanica*	Bird
Chimney swift	*Chaetura pelagica*	Bird
Chipping sparrow	*Spizella passerina*	Bird
Chuck-will's-widow	*Caprimulgus carolinensis*	Bird
Cliff swallow	*Hirundo pyrrhonota*	Bird
Common carp	*Cyprinus carpio*	Fish
Common goldeneye	*Bucephala clangula*	Bird
Common grackle	*Quiscalus quiscula*	Bird
Common loon	*Gavia immer*	Bird
Common map turtle	*Graptemys geographica*	Reptile
Common merganser	*Mergus merganser*	Bird
Common moorhen	*Gallinula chloropus*	Bird
Common musk turtle	*Sternotherus odoratus*	Reptile
Common nighthawk	*Chordeiles minor*	Bird
Common snapping turtle	*Chelydra serpentina serpentina*	Reptile
Common snipe	*Gallinago gallinago*	Bird

Common Name (Animals)	Scientific Name	Category
Common yellowthroat	*Geothlypis trichas*	Bird
Connecticut warbler	*Oporornis agilis*	Bird
Cooper's hawk	*Accipiter cooperii*	Bird
Creek chub	*Semotilus atromaculatus*	Fish
Dark-eyed junco	*Junco hyemalis*	Bird
Dark-sided salamander	*Eurycea longicauda melanopleura*	Amphibian
Deer mouse	*Peromyscus maniculatus*	Mammal
Devil crayfish	*Cambarus diogenes*	Crustacean
Dickcissel	*Spiza americana*	Bird
Double-crested cormorant	*Phalacrocorax auritus*	Bird
Downy woodpecker	*Picoides pubescens*	Bird
Dwarf American toad	*Bufo americanus charlesmithi*	Amphibian
Eastern bluebird	*Sialia sialis*	Bird
Eastern chipmunk	*Tamias striatus*	Mammal
Eastern coachwhip	*Masticophis flagellum flagellum*	Reptile
Eastern collared lizard	*Crotaphytus collaris collaris*	Reptiles
Eastern cottontail	*Sylvilagus floridanus*	Mammal
Eastern garter snake	*Thamnophis sirtalis sirtalis*	Reptile
Eastern gray treefrog	*Hyla versicolor*	Amphibian
Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*	Amphibian
Eastern hognose snake	*Heterodon platirhinos*	Reptile
Eastern kingbird	*Tyrannus tyrannus*	Bird
Eastern meadowlark	*Sturnella magna*	Bird
Eastern narrowmouth toad	*Gastrophryne carolinensis*	Amphibian
Eastern phoebe	*Sayornis phoebe*	Bird
Eastern pipistrelle	*Pipistrellus subflavus*	Mammal
Eastern screech-owl	*Otus asio*	Bird
Eastern small-footed myotis	*Myotis leibii*	Mammal
Eastern spiny softshell	*Apalone spinifer spinifer*	Reptile
Eastern tiger salamander	*Ambystoma tigrinum tigrinum*	Amphibian
Eastern towhee	*Pipilo erythrophthalmus*	Bird
Eastern wood rat	*Neotoma floridana*	Mammal

Common Name (Animals)	Scientific Name	Category
Eastern wood-pewee	*Contopus virens*	Bird
Eastern yellowbelly racer	*Coluber constrictor flaviventris*	Reptile
Elk	*Cervus elaphus*	Mammal
Elktoe	*Alasmidonta marginata*	Mollusk
Ellipse	*Venustaconcha ellipsiformis*	Mussel
European starling	*Sturnus vulgaris*	Bird
Evening grosbeak	*Coccothraustes vespertinus*	Bird
False map turtle	*Graptemys p. pseudogeographica*	Reptile
Fantail darter	*Etheostoma flabellare*	Fish
Fathead minnow	*Pimephales promelas*	Fish
Fatmucket or eastern lampmussel	*Lampsilis siliquoidea (=radiata)*	Mussel
Field sparrow	*Spizella pusila*	Bird
Five-lined skink	*Eumeces fasciatus*	Reptile
Flathead catfish	*Pylodictis olivaris*	Fish
Flathead snake	*Tantilla gracilis*	Reptile
Fluted-shell	*Lasmigona costata*	Mussel
Forster's tern	*Sterna forsteri*	Bird
Four-toed salamander	*Hemidactylium scutatum*	Amphibian
Fowler's toad	*Bufo woodhousei fowleri*	Amphibian
Fox sparrow	*Passerella iliaca*	Bird
Fragile papershell	*Leptodea fragilis*	Mussel
Freshwater drum	*Aplodinotus grunniens*	Fish
Gadwall	*Anas strepera*	Bird
Giant floater	*Pyganodon (=Anodonta) grandis*	Mussel
Gilt darter	*Percina evides*	Fish
Gizzard shad	*Dorosoma cepedianum*	Fish
Golden crayfish	*Orconectes luteus*	Crustacean
Golden eagle	*Aquila chrysaetos*	Bird
Golden mouse	*Ochrotomys nuttalli*	Mammal
Golden redhorse	*Moxostoma erythrurum*	Fish
Golden shiner	*Notemigonus crysoleucas*	Fish
Golden-crowned kinglet	*Regulus satrapa*	Bird

Common Name (Animals)	Scientific Name	Category
Golden-winged warbler	*Vermivora chrysoptera*	Bird
Goldfish	*Carassius auratus*	Fish
Grasshopper sparrow	*Ammodramus savannarum*	Bird
Gravel chub	*Erimystax x-punctatus*	Fish
Gray bat	*Myotis grisecens*	Mammal
Gray catbird	*Dumetella carolinensis*	Bird
Gray wolf	*Canis lupus*	Mammal
Graybelly salamander	*Eurycea multiplicata griseogaster*	Amphibian
Gray-cheeked thrush	*Catharus minimus*	Bird
Great blue heron	*Ardea herodias*	Bird
Great crested flycatcher	*Myiarchus crinitus*	Bird
Great egret	*Ardea albus*	Bird
Great horned owl	*Bubo virginianus*	Bird
Great Plains rat snake	*Elaphe guttata emoryi*	Reptile
Greater yellowlegs	*Tringa melanoleuca*	Bird
Green frog	*Rana clamitans melanota*	Amphibian
Green heron	*Butorides virescens*	Bird
Green sunfish	*Lepomis cyanellus*	Fish
Greenside darter	*Etheostoma blennioides*	Fish
Green-winged teal	*Anas crecca*	Bird
Grotto salamander	*Typhlotriton spelaeus*	Amphibian
Ground skink	*Scincella lateralis*	Reptile
Hairy woodpecker	*Picoides villosus*	Bird
Henslow's sparrow	*Ammodramus henslowii*	Bird
Hermit thrush	*Catharus guttatus*	Bird
Herring gull	*Larus argentatus*	Bird
Highfin carpsucker	*Carpiodes velifer*	Fish
Hooded merganser	*Lophodytes cucullatus*	Bird
Hooded warbler	*Wilsonia citrina*	Bird
Horned grebe	*Podiceps auritus*	Bird
Horned lark	*Eremophila alpestris*	Bird
Hornyhead chub	*Nocomis biguttatus*	Fish

Common Name (Animals)	Scientific Name	Category
House sparrow	*Passera domesticus*	Bird
House wren	*Troglodytes aedon*	Bird
Hybrid sunfish	*Lepomis sp.*	Fish
Indiana bat	*Myotis sodalis*	Mammal
Indigo bunting	*Passerina cyanea*	Bird
Kentucky warbler	*Oporornis formosus*	Bird
Killdeer	*Charadrius vociferus*	Bird
Largemouth bass	*Micropterus salmoides*	Fish
Largescale stoneroller	*Campostoma oligolepis*	Fish
Lark sparrow	*Chondestes grammacus*	Bird
Laughing gull	*Larus atricilla*	Bird
Least flycatcher	*Empidonax minimus*	Bird
Least sandpiper	*Calidris minutilla*	Bird
Lesser scaup	*Aythya affinis*	Bird
Lesser yellowlegs	*Tringa flavipes*	Bird
Little brown bat	*Myotis lucifugus*	Mammal
Loggerhead shrike	*Lanius ludovicianus*	Bird
Logperch	*Percina caprodes*	Fish
Longear sunfish	*Lepomis megalotis*	Fish
Longnose gar	*Lepisosteus osseus*	Fish
Long-tailed weasel	*Mustela frenata*	Mammal
Louisiana waterthrush	*Seiurus motacilla*	Bird
Magnolia warbler	*Dendroica magnolia*	Bird
Mallard	*Anas platyrhynchos*	Bird
Marbled salamander	*Ambystoma opacum*	Amphibian
Marsh wren	*Cistothorus palustris*	Bird
Merlin	*Falco columbarius*	Bird
Midland brown snake	*Storeria dekayi wrightorum*	Reptile
Midland smooth softshell	*Apalone muticus muticus*	Reptile
Mink	*Mustela vison*	Mammal
Missouri River cooter	*Pseudemys concinna metteri*	Reptile
Missouri saddled darter	*Etheostoma tetrazonum*	Fish

Common Name (Animals)	Scientific Name	Category
Monkeyface	*Quadrula metanevra*	Mussel
Mooneye	*Hiodon tergisus*	Fish
Mosquitofish	*Gambusia affinis*	Fish
Mountain lion	*Felis concolor*	Mammal
Mourning dove	*Zenaida macroura*	Bird
Mourning warbler	*Oporornis philadelphia*	Bird
Mucket	*Actinonaias ligamentina*	Mussel
Mudpuppy	*Necturus maculosus*	Amphibian
Muskrat	*Ondatra zibethicus*	Mammal
Nashville warbler	*Vermivora ruficapilla*	Bird
Northen spring peeper	*Hyla crucifer crucifer*	Amphibian
Northern bobwhite	*Colinus virginianus*	Bird
Northern broken-ray	*Lampsilis reeviana brittsi*	Mussel
Northern brook lamprey	*Ichthyomyzon fossor*	Fish
Northern cardinal	*Cardinalis cardinalis*	Bird
Northern fence lizard	*Sceloporus undulatus hyacinthinus*	Reptile
Northern flicker	*Colaptes auratus*	Bird
Northern harrier	*Circus cyaneus*	Bird
Northern hog sucker	*Hypentelium nigricans*	Fish
Northern mockingbird	*Mimus polyglottos*	Bird
Northern parula	*Parula americana*	Bird
Northern pintail	*Anas acuta*	Bird
Northern redbelly snake	*Storeria occipitomaculata occipitomaculata*	Reptile
Northern rough-winged swallow	*Stelgidopteryx serripennis*	Bird
Northern scarlet snake	*Cemophora coccinea copei*	Reptiles
Northern shoveler	*Anas clypeata*	Bird
Northern studfish	*Fundulus catenatus*	Fish
Northern water snake	*Nerodia sipedon sipedon*	Reptile
Northern waterthrush	*Seiurus noveboracensis*	Bird
Onondaga cave amphipod	*Stygobromus onondagaensis*	Crustacean
Orange-crowned warbler	*Vermicora celata*	Bird
Orangespotted sunfish	*Lepomis humilis*	Fish

Common Name (Animals)	Scientific Name	Category
Orangethroat darter	*Etheostoma spectabile*	Fish
Orchard oriole	*Icterus spurius*	Bird
Ornate box turtle	*Terrapene ornata ornata*	Reptile
Osage copperhead	*Agkistrodon contortrix phaeogaster*	Reptile
Osprey	*Pandion haliaetus*	Bird
Ouachita kidneyshell	*Ptychobranchus occidentalis*	Mussel
Ovenbird	*Seiurus aurocapillus*	Bird
Ozark broken-ray	*Lampsilis reeviana brevicula*	Mussel
Ozark minnow	*Notropis nubilus*	Fish
Ozark pigtoe	*Fusconaia ozarkensis*	Mussel
Ozark sculpin	*Cottus hypselurus*	Fish
Palm warbler	*Dendroica palmarum*	Bird
Paper pondshell	*Utterbackia (=Anodonta) imbecillis*	Mussel
Pickerel frog	*Rana palustris*	Amphibian
Pied-billed grebe	*Podilymbus podiceps*	Bird
Pileated woodpecker	*Dryocopus pileatus*	Bird
Pimpleback	*Quadrula pustulosa*	Mussel
Pine warbler	*Dendroica pinus*	Bird
Pink heelsplitter	*Potamilus alatus*	Mussel
Pistolgrip	*Tritogonia verrucosa*	Mussel
Plain pocketbook	*Lampsilis cardium*	Mussel
Plains topminnow	*Fundulus sciadicus*	Fish
Pondmussel	*Ligumia subrostrata*	Mussel
Prairie kingsnake	*Lampropeltis calligaster calligaster*	Reptile
Prairie racerunner	*Cnemidophorus sexlineatus viridis*	Reptile
Prairie ringneck snake	*Diadophis punctatus arnyi*	Reptile
Prairie vole	*Microtus ochrogaster*	Mammal
Prairie warbler	*Dendroica discolor*	Bird
Prothonotary warbler	*Protonotaria citrea*	Bird
Purple finch	*Carpodacus purpureus*	Bird
Purple martin	*Progne subis*	Bird
Purple wartyback	*Cyclonaias tuberculata*	Mussel

Common Name (Animals)	Scientific Name	Category
Quillback	*Carpiodes cyprinus*	Fish
Raccoon	*Procyon lotor*	Mammal
Rainbow darter	*Etheostoma caeruleum*	Fish
Rainbow trout	*Oncorhynchus mykiss*	Fish
Red milk snake	*Lampropeltis triangulum syspila*	Reptile
Red-bellied woodpecker	*Melanerpes carolinus*	Bird
Red-breasted nuthatch	*Sitta canadensis*	Bird
Red-eared slider	*Trachemys scripta elegans*	Reptile
Red-eyed vireo	*Vireo olivaceus*	Bird
Redfin shiner	*Lythrurus umbratilis*	Fish
Redhead	*Aythya americana*	Bird
Red-headed woodpecker	*Melanerpes erythrocephalus*	Bird
Redhorse sp.	*Moxostoma sp.*	Fish
Red-shouldered hawk	*Buteo lineatus*	Bird
Red-tailed hawk	*Buteo jamaicensis*	Bird
Red-winged blackbird	*Agelaius phoeniceus*	Bird
Ringed salamander	*Ambystoma annulatum*	Amphibian
Ring-necked duck	*Aythya collaris*	Bird
River carpsucker	*Carpiodes carpio*	Fish
River redhorse	*Moxostoma carinatum*	Fish
Rock bass	*Ambloplites rupestris*	Fish
Rock dove	*Columba livia*	Bird
Rose-breasted grosbeak	*Pheucticus ludovicianus*	Bird
Rosyface shiner	*Notropis rubellus*	Fish
Rough earth snake	*Virginia striatula*	Reptile
Rough green snake	*Opheodrys aestivus*	Reptile
Round pigtoe	*Pleurobema coccineum*	Mussel
Ruby-crowned kinglet	*Regulus calendula*	Bird
Ruby-throated hummingbird	*Archilochus colubris*	Bird
Ruddy duck	*Oxyura jamaicensis*	Bird
Ruffed grouse	*Bonasa umbellus*	Bird
Salem cave crayfish	*Cambarus hubrichti*	Crustacean

Common Name (Animals)	Scientific Name	Category
Sand shiner	*Notropis stramineus*	Fish
Savannah sparrow	*Passerculus sandwichensis*	Bird
Scarlet tanager	*Piranga olivacea*	Bird
Scissor-tailed flycatcher	*Tyrannus forficatus*	Bird
Sedge wren	*Cistothorus platensis*	Bird
Semipalmated sandpiper	*Calidris pusilla*	Bird
Sharp-shinned hawk	*Accipiter striatus*	Bird
Shorthead redhorse	*Moxostoma macrolepidotum*	Fish
Shortnose gar	*Lepisosteus platostomus*	Fish
Silver redhorse	*Moxostoma anisurum*	Fish
Skipjack herring	*Alosa chrysochloris*	Fish
Slender madtom	*Noturus exilis*	Fish
Slenderhead darter	*Percina phoxocephala*	Fish
Slippershell mussel	*Alasmidonta viridis*	Mussel
Smallmouth bass	*Micropterus dolomieu*	Fish
Smallmouth buffalo	*Ictiobus bubalus*	Fish
Snow goose	*Chen caerulescens*	Bird
Snowy egret	*Egretta thula*	Bird
Softshell turtles	*Trionyx* spp.	Reptile
Solitary vireo	*Vireo solitarius*	Bird
Song sparrow	*Melospiza melodia*	Bird
Sora	*Porzana carolina*	Bird
Southern coal skink	*Eumeces anthracinus pluvialis*	Reptile
Southern leopard frog	*Rana utricularia*	Amphibian
Southern redback salamander	*Plethodon serratus*	Amphibian
Southern redbelly dace	*Phoxinus erythrogaster*	Fish
Speckled kingsnake	*Lampropeltis getula holbrooki*	Reptile
Spectaclecase	*Cumberlandia monodonta*	Mollusk
Spike	*Elliptio dilatata*	Mussel
Spotfin shiner	*Cyprinella spiloptera*	Fish
Spothanded crayfish	*Orconectes punctimanus*	Crustacean
Spotted bass	*Micropterus punctulatus*	Fish

Common Name (Animals)	Scientific Name	Category
Spotted salamander	*Ambystoma maculatum*	Amphibian
Spotted sandpiper	*Actitis macularia*	Bird
Squawfoot	*Strophitus undulatus*	Mussel
Stippled darter	*Etheostoma punctulatum*	Fish
Stonecat	*Noturus flavus*	Fish
Striped shiner	*Luxilus chrysocephalus*	Fish
Striped skunk	*Mephitis mephitis*	Mammal
Summer tanager	*Piranga rubra*	Bird
Swainson's thrush	*Catharus ustulatus*	Bird
Swainson's warbler	*Limnothlypis swainsonii*	Bird
Tennessee warbler	*Vermivora peregrina*	Bird
Threehorn wartyback	*Obliquaria reflexa*	Mussel
Threeridge	*Amblema plicata*	Mussel
Three-toed box turtle	*Terrapene carolina triunguis*	Reptile
Timber rattlesnake	*Crotalus horridus*	Reptile
Tree swallow	*Tachycineta bicolor*	Bird
Tufted titmouse	*Parus bicolor*	Bird
Tundra swan	*Cygnus columbianus*	Bird
Turkey vulture	*Cathartes aura*	Bird
Unknown minnow	*Cyprinidae sp.*	Fish
Veery	*Catharus fuscescens*	Bird
Virginia rail	*Rallus limicola*	Bird
Wabash pigtoe	*Fusconaia flava*	Mussel
Walleye	*Stizostedion vitreum*	Fish
Warbling vireo	*Vireo gilvus*	Bird
Wedgespot shiner	*Notropis greenei*	Fish
Western chorus frog	*Pseudacris triseriata triseriata*	Amphibian
Western cottonmouth	*Agkistrodon piscivorus leucostoma*	Reptile
Western earth snake	*Virginia valeriae elegans*	Reptile
Western painted turtle	*Chrysemys picta bellii*	Reptile
Western ribbon snake	*Thamnophis proximus proximus*	Reptile
Western slender glass lizard	*Ophisaurus attenuatus attenuatus*	Reptile

Common Name (Animals)	Scientific Name	Category
Western slimy salamander	*Plethodon albagula*	Amphibian
Western spiny softshell	*Apalone spinifera hartwegi*	Reptile
Western worm snake	*Carphophis vermis*	Reptile
Whip-poor-will	*Caprimulgus vociferus*	Bird
White crappie	*Pomoxis annularis*	Fish
White sucker	*Catostomus commersoni*	Fish
White-breasted nuthatch	*Sitta carolinensis*	Bird
White-crowned sparrow	*Zonotrichia leucophrys*	Bird
White-eyed vireo	*Vireo griseus*	Bird
White-footed mouse	*Peromyscus leucopus*	Mammal
White-tailed deer	*Odocoileus virginianus*	Mammal
White-throated sparrow	*Zonotrichia albicollis*	Bird
Wild turkey	*Meleagris gallopavo*	Bird
Willow flycatcher	*Empidonax traillii*	Bird
Wilson's phalarope	*Phalaropus tricolor*	Bird
Wilson's warbler	*Wilsonia pusilla*	Bird
Winter wren	*Troglodytes troglodytes*	Bird
Wood duck	*Aix sponsa*	Bird
Wood thrush	*Hylocichla mustelina*	Bird
Worm-eating warbler	*Helmitheros vermivorus*	Bird
Yellow bullhead	*Ameiurus natalis*	Fish
Yellow sandshell	*Lampsilis teres*	Mussel
Yellow warbler	*Dendroica petechia*	Bird
Yellow-bellied sapsucker	*Sphyrapicus varius*	Bird
Yellow-billed cuckoo	*Coccyzus americanus*	Bird
Yellow-breasted chat	*Icteria virens*	Bird
Yellow-crowned night-heron	*Nyctanessa violaceus*	Bird
Yellow-rumped warbler	*Dendroica coronata*	Bird
Yellow-throated vireo	*Vireo flavifrons*	Bird
Yellow-throated warbler	*Dendroica dominica*	Bird

Scientific Name (Plants)	Common Name	Category
Acalypha gracilens A. Gray		Plant
Acer negundo	Box-elder	Plant
Acer rubrum L.		Plant
Acer saccharum	Sugar maple	Plant
Acer spp.	Maple	Plant
Achillea millefolium L. var. *lanulosa* (Nutt.) Piper ex Piper & Beattie		Plant
Aeschulus glabra	Buckeye	Plant
Agalinis purpurea	Purple false foxglove	Plant
Agalinis skinneriana	A false foxglove	Plant
Agalinis tenuifolia (M.Vahl) Raf.		Plant
Agrimonia gryposepala	Tall agrimony	Plant
Agrostis elliottiana Schultes		Plant
Agrostis hyemalis (Walter) Britton, Sterns & Pogg var. *hyemalis*		Plant
Agrostis perennans (Walter) Tuckerman		Plant
Allium canadense L.		Plant
Allium canadense L. var. *canadense*		Plant
Allium canadense L. var. *mobilense* (Regal) F. Ownbey		Plant
Alopecurus aequalis	Floating foxtail	Plant
Alopecurus carolinianus Walter		Plant
Ambrosia artemisiifolia L.		Plant
Ambrosia bidentata Michaux		Plant
Amsonia illustris Woodson		Plant
Andropogon gerardii Vitman var. *gerardii*		Plant
Anemonella thalictroides (L.) Spach. f. *thalictroides*		Plant
Antennaria plantaginifolia (L.) Hook		Plant
Arenaria serpyllifolia L.		Plant
Aristida dichotoma Michaux var. *dichotoma*		Plant
Aristida longespica Poiret var. *longespica*		Plant
Aristida purpurascens Poiret		Plant
Armoracia lacustris	Lake cress	Plant
Asclepias tuberosa L.		Plant
Asclepias viridiflora Raf.		Plant

Scientific Name (Plants)	Common Name	Category
Asimina triloba	Paw paw	Plant
Asplenium platyneuron (L.) Britton, Sterns & Pogg. var. *platyneuron*		Plant
Aster anomolus Engelm. f. *anomolus.*		Plant
Aster furcatus	Forked aster	Plant
Aster laevis L.		Plant
Aster lateriflorus (L.) Britton		Plant
Aster linariifolius L. var. *linariifolius* f. *linariifolius*		Plant
Aster macrophyllus	Big-leaved aster	Plant
Aster oolentangiensis Riddell var. *oolentangiensis*		Plant
Aster patens Dryander		Plant
Aster pilosus Willd.		Plant
Aster sericeus Vent f. *sericeus*		Plant
Aster spp.	Aster	Plant
Baptisia alba (L.) Vent.		Plant
Baptisia bracteata Muhlenb. ex Elliot		Plant
Barbarea vulgaris R.Brown var. *arcuata*		Plant
Berberis canadensis	American barberry	Plant
Betula nigra	Birch	
Bidens aristosa (Michaux) Britton f. *aristosa*		Plant
Bromus latiglumis	Brome grass	Plant
Bryum capillare Hedw.		Plant
Bulbostylis capillaris (L.) C.B. Clarke		Plant
Bumelia lanuginosa (Michaux) Pers.		Plant
Cacalia plantaginea (Raf.) Shinners		Plant
Calamagrostis porteri ssp. *insperata*	Reed bent grass	Plant
Callitriche heterophylla Pursh var. *heterophylla*		Plant
Caloplaca spp.		Plant
Camassia scilloides (Raf.) Cory f. *scilloides*		Plant
Cardamine concatenata (Michaux) O. Schwarz		Plant
Cardamine parviflora L. var. *arenicola* (Britton) O. Schwarz		Plant
Carex alata	Broadwing sedge	Plant

Scientific Name (Plants)	Common Name	Category
Carex aquatilis var. *aquatilis*	Water sedge	Plant
Carex aristatus Rottb.		Plant
Carex brevior (Dewey) Mackenzie ex Lunell		Plant
Carex bushii Mackenzie		Plant
Carex buxbaumii	Brown bog sedge	Plant
Carex cephalophora Willd.		Plant
Carex comosa	Bristly sedge	Plant
Carex complanata Torrey & Hook. var. *hirsuta* (L. Baily) Gleason		Plant
Carex conoidea	Field sedge	Plant
Carex fissa var. *fissa*	A sedge	Plant
Carex flaccosperma Dewey var. *glaucodea* (Tuckerman) Kük		Plant
Carex frankii Kunth		Plant
Carex gravida L. Baily		Plant
Carex laevivaginata	Smooth-sheath sedge	Plant
Carex meadii Dewey		Plant
Carex straminea	Straw sedge	Plant
Carex stricta	Tussock sedge	Plant
Carex triangularis	Triangular sedge	Plant
Carex trichocarpa	Hairy-fruited sedge	Plant
Carex virescens	Ribbed sedge	Plant
Carex vulpinoidea Michaux		Plant
Carya spp.	Hickory	
Carya texana Buckley	Black hickory	Plant
Carya tomentosa	Mockernut hickory	Plant
Celtis occidentalis	Hackberry	
Celtis tenuifolia Nutt. var. *tenuifolia*		Plant
Cephalanthus occidentalis L.	Buttonbush	Plant
Cerastium brachypetalum Pers.		Plant
Cerastium fontanum Baumg.		Plant
Cercis canadensis L.	Redbud	Plant
Chaerophyllum procumbens (L.) Crantz		Plant
Chamaecrista fasciculata (Michaux) E. Greene		Plant

Scientific Name (Plants)	Common Name	Category
Chamaesyce maculata (L.) Small		Plant
Chamaesyce nutans (Lag.) Small		Plant
Chasmanthium latifolium (Michaux) Yates	Sea oats	Plant
Cheilanthes lanosa (Michaux) D. Eaton		Plant
Cladina cristatella Tuck.		Plant
Cladina spp.		Plant
Cladonia dimorphoclada Robbins		Plant
Cladonia robbinsii Evens .		Plant
Cladonia spp.		Plant
Clematis viorna	A leather flower	Plant
Coreopsis lanceolata L.		Plant
Cornus amomum Miller ssp. *obliqua* (Raf.) J. Wilson		Plant
Cornus florida L.		Plant
Cornus spp.	Dogwood	Plant
Corylus americana	Hazelnut	Plant
Croton capitatus Michaux var. *captitatus*		Plant
Crotonopsis elliptica Willd.		Plant
Crotonopsis linearis	Narrowleaf rushfoil	Plant
Cuphea viscosissima Jacq.		Plant
Cuscuta pentagona Engelm.		Plant
Cyperus acuminatus Torrey & Hook.		Plant
Cypripedium reginae	Showy lady's slipper	Plant
Cystopteris tennesseensis Shaver		Plant
Dactylis glomerata L.		Plant
Danthonia spicata (L.) P. Beauv. ex Roemer & Schultes var. *spicata*		Plant
Delphinium carolinianum Walter ssp. *carolinianum*		Plant
Dermatocarpon spp.		Plant
Desmodium viridiflorum	Velvety tick trefoil	Plant
Dianthus armeria L.		Plant
Dichanthelium acuminatum (Sw.) Gould & C. A. Clark var. *acuminatum*		Plant
Dichanthelium leibergii	Panic grass	Plant

Scientific Name (Plants)	Common Name	Category
Digitaria cognata (Schultes) Pilger var. *cognata*		Plant
Diodia teres Walter		Plant
Diospyros virginiana L. var. *platycarpa* Sarg. f. *platycarpa*		Plant
Dodecatheon meadia L. var. *brachycarpum* (Small) Fasset f. *brachycarpum*		Plant
Draba brachycarpa Nutt ex Torrey & A. Gray		Plant
Dryopteris carthusiana	Spinulose shield fern	Plant
Dryopteris goldiana	Goldie's fern	Plant
Dryopteris marginalis (L.) A. Gray		Plant
Elatine triandra	Waterwort	Plant
Elocharis compressa Sullivant		Plant
Elocharis obtusa (Willd.) Schultes var. *obtusa*		Plant
Elymus canadensis L.		Plant
Entodon seductrix (Hedw.) Muell		Plant
Equisetum hymale L. var. *affine* (Engelm.) A. A. Eaton		Plant
Erigeron strigosus Muhlenb. ex Willd var. *beyrichii* Torrey & A. Gray		Plant
Erigeron strigosus Muhlenb. ex Willd. var. *beyrichii*		Plant
Eryngium yuccifolium Michaux		Plant
Eupatorium spp.	Boneset	Plant
Euphorbia corollata L.		Plant
Euphorbia dentata Michaux		Plant
Festuca pratensis Hudson		Plant
Fimbristylis autumnalis (L.) Roemer & Schultes		Plant
Fimbristylis puberula (Michaux) M. Vahl var. *puberula*		Plant
Fraxinus americana L.		Plant
Fraxinus spp.	Ash	
Galium circaezans Michaux var. *circaezans*		Plant
Galium obtusum Bigelow ssp. *obtusum*		Plant
Gentiana puberulenta J. Pringle		Plant
Geum vernum (Raf.) Torrey & A. Gray		Plant
Glandularia canadensis (L.) Nutt.		Plant
Glyceria acutiflora	Sharp-scaled manna grass	Plant

Scientific Name (Plants)	Common Name	Category
Gnaphalium obtusifolium L. var. *obtusifolium*		Plant
Gratiola neglecta Torrey		Plant
Grimmia laevigata (Brid.) Brid.		Plant
Hedwigia cilliata (Hedw.) Ehrh. ex P. Beauv.		Plant
Hedyotis crassifolia Raf.		Plant
Helianthus mollis Lam.		Plant
Heliopsis helianthoides (L.) Sweet var. *occidentalis* (T. Fisher) Steyerm.		Plant
Heuchera parviflora var. *parviflora*	Little leaved alum root	Plant
Heuchera x hirsuticaulis (Wheelock) Rydb.		Plant
Hibiscus spp.		Plant
Hieracium gronovii L.		Plant
Hypericum gentianoides (L.) Britton		Plant
Hypericum punctatum Lam.		Plant
Hypoxis hirsuta (L.) Cov. f. *villosissima*		Plant
Juglans cinerea	Butternut	Plant
Juglans nigra	Black walnut	Plant
Juncus balticus var. *littoralis*	Baltic rush	
Juncus brachycarpus Engelm.		Plant
Juncus interior Wieg.		Plant
Juncus torreyi Cov.		Plant
Juniperus virginiana	Eastern redcedar	
Juniperus virginiana L. var. *virginiana*		Plant
Krigia biflora (Walter) S.F. Blake		Plant
Krigia dandelion (L.) Nutt.		Plant
Krigia virginica (L.) Willd.		Plant
Leersia oryzoides (L.) Sw.		Plant
Leersia virginica Willd.		Plant
Lepedium campestre (L.) R.Br.		Plant
Lepedium virginicum L. var. *virginicum*		Plant
Lespedeza repens (L.) Barton		Plant
Leucospora multifida (Michaux) Nutt.		Plant

Scientific Name (Plants)	Common Name	Category
Liatris cylindracea	Blazing star	Plant
Liatris pycnostachya Michaux var. *pycnostachya*		Plant
Lindera benzoin	Spice bush	
Lindera benzoin (L.) Blume var. *pubescens* (Palmer & Steyerm.) Rehder		Plant
Linum medium (Planchon) Britton var. *texanum*		Plant
Lipocarpha micrantha (M. Vahl) G. Tucker		Plant
Lobelia spicata Lam.		Plant
Lonicera flava Sims		Plant
Ludwigia alternifolia L.		Plant
Luzula bulbosa (Alph. Wood) Rydb.		Plant
Lythrum alatum Pursh var. *alatum*		Plant
Malaxis unifolia	Green adder's mouth	Plant
Matelea baldwyniana	Baldwin's milkvine	Plant
Melica nitens (Scibner) Nutt.		Plant
Monarda bradburniana Beck .		Plant
Monarda fistulosa L. ssp. *fistulosa*		Plant
Morus spp.	Mulberry	Plant
Najas gracillima	Thread-like naiad	Plant
Nemastylis nuttallii	Celestial lily	Plant
Nothoscordum bivalve (L.) Britton		Plant
Nuttallanthus canadensis (L.) D. Sutton		Plant
Oenothera linifolia Nutt.		Plant
Opuntia humifusa (Raf.) Raf. var. *humifusa*		Plant
Oxalis violacea L.		Plant
Panicum depauperatum Muhlenb.		Plant
Panicum flexile (Gattinger) Scribner		Plant
Panicum philadelphicum Trin. var. *philadelphicum*		Plant
Panicum virgatum L.		Plant
Parmotrema hypotropum (Nyl.) Hale		Plant
Paronychia fastigiata (Raf.) Fern. var *paleacea* Fern		Plant
Paronychia fastigiata (Raf.) var. *paleacea* Fern.		Plant

Scientific Name (Plants)	Common Name	Category
Parthenium hispidum Raf.		Plant
Passiflora lutea L. var. *glabriflora* Fern.		Plant
Peltigera cf. rufescens (Weiss) Humb.		Plant
Penstemon pallidus Small		Plant
Petalostemon spp.		
Phlox pilosa L. ssp. *ozarkana* (Wherry) Wherry		Plant
Physocarpus opulifolius (L.) Maxim var. *intermedius* (Rydb.) Robinson		Plant
Pinus echinata	Shortleaf pine	Plant
Plantago aristata Michaux		Plant
Plantago cordata	Heart-leaved plantain	Plant
Plantago lanceolata L.		Plant
Plantago pusilla Nutt. var. *pusilla*		Plant
Plantago virginica L.		Plant
Platanus occidentalis L.	Sycamore	Plant
Poa palustris L..		Plant
Polygala sanguinea L. f. *sanguinea*		Plant
Polygala verticillata L.		Plant
Polygonum tenue Michaux		Plant
Polystichum acrostichoides	Christmas fern	Plant
Polytrichium juniperinum Hedw.		Plant
Portulaca oleracea L.		Plant
Potamogeton pusillus var. *pusillus*	Slender pondweed	Plant
Prunus hortulana L.		Plant
Prunus mexicana S. Watson		Plant
Prunus serotina	Wild cherry	Plant
Pseudoparmelia baltimorensis (Gyel. & For.) Hale		Plant
Pycnanthemum tenuifolium Scrader		Plant
Quercus alba L.	White oak	Plant
Quercus marilandica Muenchh.	Blackjack oak	Plant
Quercus prinoides	Dwarf chinkapin oak	Plant
Quercus rubra	Red oak	Plant

Scientific Name (Plants)	Common Name	Category
Quercus spp.	Oak	
Quercus stellata	Post oak	Plant
Quercus stellata Wangenh. var. *stellata*		Plant
Quercus velutina	Black oak	Plant
Quercus velutina Lam. f. *velutina*		Plant
Ranunculus fascicularis Muhlenb. ex. Bigelow		Plant
Ranunculus harveyi (A. Gray) Britton f. *harveyi*		Plant
Rhamnus caroliniana Walter		Plant
Rhus aromatica Aiton		Plant
Rhus copallina L.		Plant
Rhus glabra L.		Plant
Rhus spp.	Sumac	
Rhynchospora globularis (Chapman) Small var. *recognita* Gale		Plant
Rosa carolina L.		Plant
Rosa setigera Michaux var. *setigera* f. *setigera*		Plant
Rosa setigera Michaux var. *tomentosa* Torrey & A. Gray f. *tomentosa*		Plant
Rotala ramosior (L.) Koehne		Plant
Rubus flagellaris Willd.		Plant
Rubus invisus (L. Baily) Britton		Plant
Rudbeckia missouriensis Pursh	Missouri coneflower	Plant
Rumex acetosella L.		Plant
Sabatia angularis (L.) Pursh		Plant
Sabatia angularis (L.) Pursh f. *angularis*		Plant
Sabatia angularis (L.) Pursh f. *albiflora* House		Plant
Salix caroliniana Michuax		Plant
Sassafras albidum	Sassafras	Plant
Schizachyrium scoparium (Michaux) Nash		Plant
Schrankia nuttalli (DC. ex Britton & Rose) Standely		Plant
Scirpus americanus (= *S. pungens* = *s. olneyi*)	Olney's bullrush	
Scirpus pendulas Muhlenb. ex Elliot		Plant
Scirpus torreyi	Torrey's bullrush	Plant

Scientific Name (Plants)	Common Name	Category
Scleria ciliata var. *ciliata*	Hairy nut-rush	Plant
Sedum ternatum	Wood stonecrop	Plant
Silene regia Sims	Royal catchfly	Plant
Sisyrinchium atlanticum	Eastern blue-eyed grass	Plant
Sisyrinchium campestre E. Bickn. f. *campestre*		Plant
Smallanthus uvedalius	Yellow-flowered leafcup	Plant
Solanum carolinense L. var. *carolinense*		Plant
Solidago nemoralis Dryander	Gray goldenrod	Plant
Solidago petiolaris Aiton		Plant
Solidago ulmifolia Muhlenb. ex Willd.		Plant
Sphenopholis obtusata (Michaux) Scribner var. *obtusata*		Plant
Spiranthes lacera var. *gracilis*	Slender ladies' tresses	Plant
Spiranthes lucida	Shining ladies'tresses	Plant
Spiranthes ovalis var. *erostellata*	Oval ladies' tresses	Plant
Spiranthes tuberosa Raf.		Plant
Spiranthes vernalis Engelm & A. Gray		Plant
Sporabolus clandestinus (Biehler) A. Hitch.		Plant
Sporabolus vaginiflorus (Torrey) Alph. Wood		Plant
Sporobolus asper (Michaux) Kunth var. *asper*		Plant
Sporobolus ozarkanus Fern.	Bald grass, Ozark dropseed	Plant
Staphylea trifolia	Bladdernut	Plant
Strophostyles helvola (L.) Elliott var. *helvola*		Plant
Stylosanthes biflora (L.) Britton, Stearns & Pogg		Plant
Symphoricarpos orbiculatus Moench		Plant
Talinum calycinum Engelm.		Plant
Tephrosia virginiana (L.) Pers.		Plant
Torreyochloa pallida	Pale manna grass	Plant
Toxicodendron radicans (L.) Kuntze		Plant
Tradescantia ohiensis Raf.		Plant
Tragia betonicifolia Nutt.		Plant
Tridens flavus (L.) A. Hitch. var. *flavus*		Plant
Trifolium reflexum L. var. *reflexum*	Buffalo clover	Plant

Scientific Name (Plants)	Common Name	Category
Trifolium stolonifera	Running buffalo clover	Plant
Triodanis perfoliata (L.) Niewl. f. *perfoliata*		Plant
Triosteum angustifolium var. *earnesii*	Yellow-flowered horse gentian	Plant
Ulmus rubra Muhlenb.	Slippery elm	Plant
Ulmus spp.	Elm	
Vaccinium arboreum Marshall		Plant
Vernonia arkansana DC.		Plant
Veronica arvensis L.		Plant
Viburnum lentago	Nannyberry	
Viburnum rufidulum Raf..		Plant
Viola pedata L. f. *pedata*		Plant
Viola rafinesquii Greene		Plant
Viola sororia Willd. f. *sororia*		Plant
Vitis aestivalis Michaux		Plant
Vitis spp.	Grape	Plant
Vulpia octoflora (Walter) Rydb. var. *glauca* (Nutt.) Fern.		Plant
Waldsteinia fragarioides ssp. *fragarioides*	Barren strawberry	Plant
Zigadenus elegans	White camus	Plant

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